THE PETTY PAPERS

* * *

Some unpublished
writings of
Sir William Petty
from
the Bowood Papers

* * *

Edited by
The Marquis of
Lansdowne

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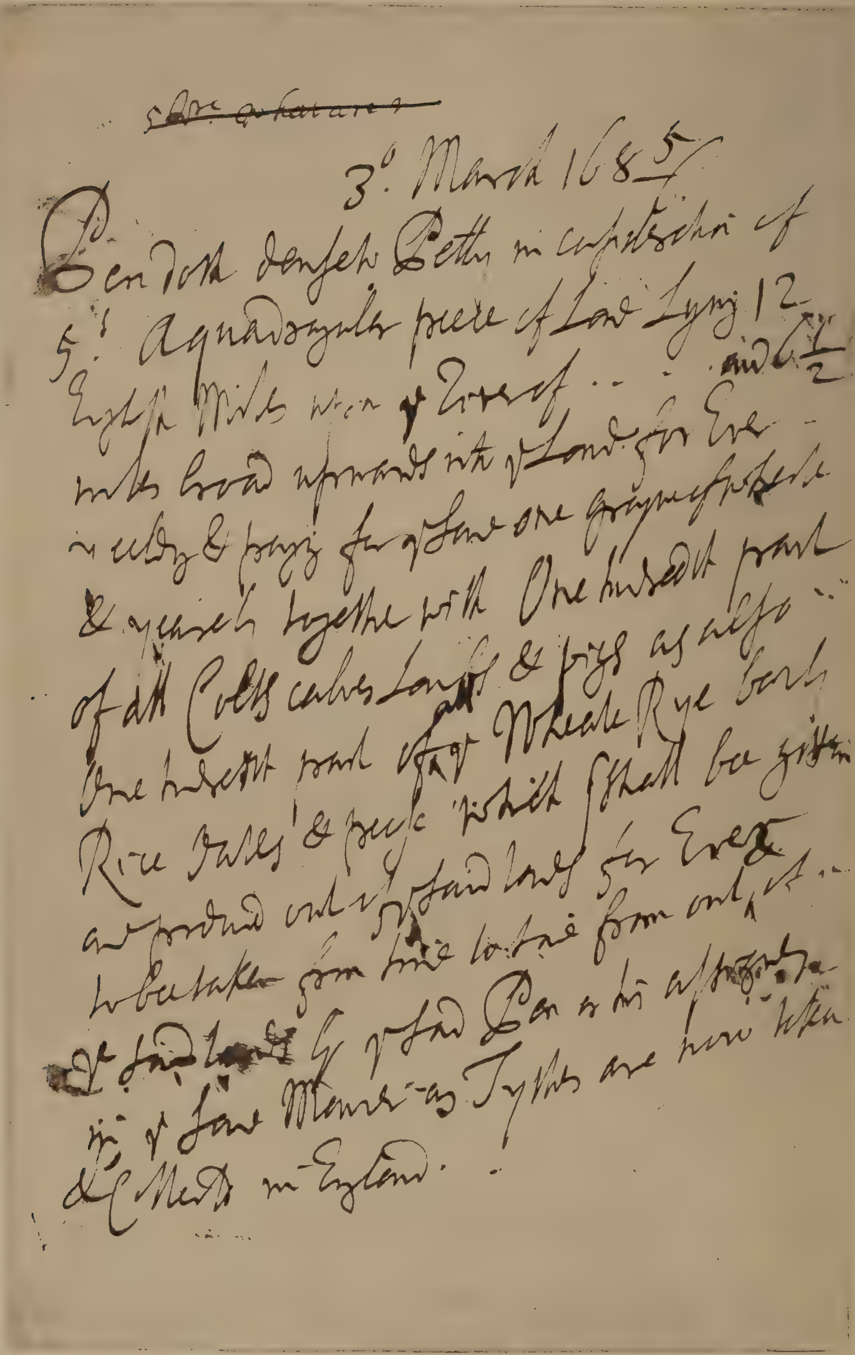
THE PETTY PAPERS

"My singular friend . . . a person of an admirable inventive head and practical parts. . . . Since his death I have seen in his closet a great many tractatiuncli in MS."

AUBREY, *Brief Lives*, 1898, vol. ii, 146.



~~[illegible]~~

3° March 168$\frac{5}{6}$

Pen doth demise to Petty in consideration of
5s a quadrangular piece of Land Lying 12
English Miles upon ye River ... and 6$\frac{1}{2}$
miles broad upwards into ye Land for Ever
yeilding & paying for ye same one graine of pepper
& yearely together with One hundredth part
of all Colts calves Lambs & pigs as also
One hundredth part of all Wheate Rye barly
Rice Oates & pease which shall be gotten
and produced out of ye said lands for Ever
to be taken from time to time from out of
~~ye said lands~~ by ye said Pen or his assignes
in ye same Manner as Tythes are now taken
& Collected in England.

AN AGREEMENT BETWEEN PENN AND PETTY
ABOUT A COLONY IN PENNSYLVANIA
(No. 115)

THE PETTY PAPERS

Some unpublished writings
of
SIR WILLIAM PETTY

Edited from the Bowood Papers
by the
MARQUIS OF LANSDOWNE

IN TWO VOLUMES
VOL. II

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XI

EDUCATION

(81) Three sorts of Education—(82) Books for Charles and Henry Petty—(83) Exercises of Sense and Reason—(84) An Examination Paper—(85) Methodus ad Magistratum in Artibus—(86) Of Algebra.

EDUCATION

MUCH of the Petty-Southwell Correspondence is taken up by discussions on the Education and upbringing of Children, more particularly in relation to those of the two writers. Petty's attention seems to have been specially turned towards this subject in the year 1686, when he wrote out for the education of his sons the 'Directions' which were published in his *Life* (Fitzmaurice, 302-304). The ensuing papers are on much the same lines.

In No. 81 he gives his ideas of *Three sorts of Education*, suitable (as it would appear from their details) for the making of a successful man of the world, for a 'fop' or courtier, and for a lawyer respectively. No. 82 contains a list of books recommended for his sons—Charles born in 1672 and Henry in 1673—somewhat fuller than that given in the 'Directions' above mentioned, while his daughter Anne (born 1675) is not forgotten and is recommended to study economics as well as gardening, cookery, and clothes. *Exercises of Sense and Reason* (No. 83) lays down the educational procedure to be observed between the ages of 1 and 17, and appears from the script to have been written in Petty's earlier years. No. 84 has no heading or endorsement. I have called it *An Examination Paper*, though for such an all-embracing enquiry into men and things, this description is perhaps scarcely adequate.

Petty's heading, *Methodus ad Magistratum in Artibus*, explains the object of No. 85, which was evidently the institution of a Scientific College, similar to that which Evelyn had advocated some years before. From the mention of Gresham College it may be surmised that the academy in which the 'Masters in Arts' were to be trained was to be established in connection therewith. Petty had for some years been Professor of Music at Gresham, and the Philosophical conclave of which he was so prominent a member held their sittings there for many years after their first installation as 'The Royal Society.' The founding of a school at Gresham would thus have been an object which would have had a special appeal to Petty and to the members of that Society.

No. 86, *Of Algebra*, was written in the form of a letter to

Southwell, only six weeks before Petty's death (3rd November 1687). Since it is more in the nature of an Essay than of a letter, I have printed it in this volume rather than in the *Correspondence*. Southwell attached great importance to this document (*Corr.*, 26th November 1687, and Introduction, xxix), and it appears to have been freely circulated amongst his friends, for there are several copies of it among the papers. It constitutes in fact Petty's vindication of his method, which he might (and perhaps should) have called Political "Algebra" since, as he himself explains, its object was to reduce terms of matter to terms of number. He preferred, however, to call it Political "Arithmetic," and there can be no doubt that both the method and the name were of his own invention.

No. 81

Three Sorts of Education 1686

(A)

1. Latine, French &c.
2. To write any hand.
3. Printing and designing.
4. Fencing & gymnastics.
5. Singing at sight.
6. Geometry, Arithmetic & Algebra.
7. Anatomy & Chirugery.
8. History of Trades.
9. Cookery & Pharmacy.
10. [Ars Veneris.][1]
11. Jugling & Legerdemain.
12. Physicall secrets, receipts & experiments.
13. Optics, Magnetics, Jewelling.

(B)

1. Dancing & Vaulting.
2. To understand a horse & riding.

---

[1] This item has been struck out in the MS. Second thoughts no doubt suggested that it was somewhat unsuitable for boys in their early 'teens.

3. To Play at severall games.
4. The Art of Treating & dressing.
5. The small moralls.
6. Histrionic.
7. Hunting & Hawking.

(C)

1. To read the Scriptures.
2. Roman story.
3. Our owne country's story.
4. Epitomy of the world.
5. Geography.
6. Table of Chronology.
7. The Lawes & Statutes.
8. The office of sheriff, executor, Justice.
9. The genealogy & relation of familyes.
10. Parliament Lawes & practice.
11. The gazettes &c.
12. All the offices of Curia and Aula.

No. 82

BOOKES FOR CHARLES & HENRY, FROM 14 TO 18 YEARS OF AGE

Cooke upon Littleton, The termes of the Law, Justinian's Institutions, Aristotle's Rhetorick, Hobs Logick & De Cive, Tullie's Offices, Erasmus Colloquies, Caesar, Sallust, Tacitus, Florus (?), Suetonius, Virgill's Georgick, 6 first chapters of Genesis, St. Luke's Gospel and Acts of the Apostles, Peter, James, John, & Jude's general Epistles, Josephus, Moliere, Geometry & Arithmetic, Baker's Chronicles, Reynard & Aesop, Gazettes, Maps & Globes, Anatomy & Ars Parva, Dispensatory.

Charles.

Comicks, Flute, Dance, Fence, Horse, Coach, Ship, House, Garden, Army, Courts.

Henry.

Sing, Fence, Ride, Lattine, Scriptures, Chronicles, Attorney craft, Writing & Arithmetic, Office & Courts.

Anne.

Oeconomicks, Garden, Cookery, Clothes.

No. 83

Exercises of Sense and Reason

From 1 to 3. They[1] are to be observed: viz, how soon they learne to speake and how apt to imitate any thing they see.

From 3 to 5. Learne to reade, number, and know their caracters. Addition and subtraction in severall forms (by head onely), and to know the names of the things which they see. Prayers and catechism. Matters of faith and sense.

From 5 to 7. To write, beginning with great capitalls in chalk, then with a pen to draw plainer. To proceed in numbering in greater forms with the pen. Musick by voice. To distinguish and name colors, tastes, smells, sounds, and all the qualities and schemes of matter, and to know weights, measures, severall coynes.

From 7 to 9. To coppy the pictures of all things, as beasts, birds, fishes, plants &c. Multiplication and division in arithmetic. Geographicall maps. Usuall, naturall and coelestiall phœnomena, in the mother tongue without booke. To practice some small trade and manufacture. Proceed in musicall instruments. To know herbs and constellations. The definitions and axioms of geometry.

From 9 to 11. [Learne the] History of their owne country in the latest tymes. Romances and play books for languages. Acting playes. Read newes of states in actions. Know [how] to handle geometry. Understand military termes. Explication how artificiall things are made. History of nature.

---

[1] *I.e.*, children.

From 11 to 13. A Catechisme of the lawes of the land. Continue geometry, arithmetic, drawing. History, civill, naturall, and of art. Explication of the termes of all arts, liberall and others. A catechisme of the most certayne medicinall rules for preservation of health.

From 13 to 15. Universall grammar, first applied in the mother tongue, then the Latin tongue, and others in more use and service; *caeteris continuatis*.

From 15 to 17. Logick.

From 17 to —. Travell.

[Some further notes on the same subject.]

Policy, statesmen, military officers, Divinity, Law, Rhetorick, Forraigne & Home accompt, husbandry, handicraft, secretary, clerk, accomptants, privat magistrates, courtier and servant of [*illegible*], Marriner, Traveller, Philologus, Poetry.

Of time and space. Sight, to judge exactly of coulers and their diff[erences]; eares, of sounds in respect of species, and noses [for] smell, taste, and feeling.[1]

Riding, dancing, leaping, vaulting, lifting, throwing, shooting in bowes and guns, swimming, running, travelling, wrestling, tennis, ringing, fencing, posture and gesture in salutes, voice, singing, imitating birds, speaking inwardly, hollowing, wind instruments, pronouncing any words, imitating another's speech, exercises belonging to severall games and trades, the use of games of meer skill (as cards and dice &c.) and composed of chance, exercise, and skill.

* * * *

Hindrance of the advancement of learning hath beene because thought, theory, and practice, hath beene always divided in severall persons; because the wayes of learning are too tedious for them to be joyned. And whereas all writings ought to be descriptions of things, they are now onely of words, notions, opinions, theories—because the writers of books know little of things, and the practicall men have not language nor method enough to describe [them] by words.

---

[1] *Cf.* Hobbes, *Leviathan*, chap. i.

No. 84

[? An Examination Paper]

1. Algebra—(Vieta. Harriott. Des Cartes. Roberval. Van Schoten. Fermat. Noring [? Norwood]. Adrian [van] Roomen. Oughtred. Pell. Wallis.)
2. Geometry.
3. Decyphering.
4. Chesse.
5. Games at cards (as Gleek, Cribage, Hombre)—at Dice (as Backgammon, Trecktrac).
6. Medicine, at least in diagnosis and prognosis.
7. Res Aulicae and politicae.
8. Amores.
9. Discovering the fact in Crimes and frawds, false tests, mony, and deeds.
10. Emprovement of Mechanics of ships, carriages, boates, pumps.
11. Study of the Law.
12. Oratory and the means of perswading.
13. Memory and the art thereof.
14. Romancing and fiction, of things likely and others.
15. Music.
16. Painting.
17. Dramatics.
18. Architecture.

19. Art Military.
20. Magnetics.
21. Legerdemain or Hocus Pocus. Prestigiae.
22. Hunting and Fishing &c.
23. Deducing doctrines and consequences from the Scriptures.

Name the principall data out of which and upon which each of these faculties do work.

In England & France, Spaine, Italy, Germany.

Let ten men of greatest fame for each of these 24 matters [1] bee named for the present century.

No. 85

METHODUS AD MAGISTRATUM IN ARTIBUS (1686)

Let there be a *supellex Philosophica* (elsewhere described) worth 500£.[2]

Let the Students of the Schoole have Languages, exercises and Draught, with a competency of Arithmetic, Algebra, Geometry, Geography and Chronology.

Of motions and Mechanics.
Of sounds, echoes, and Musick.
Of Opticks, visions, and scenes.
Of Magneticks.
Of ships and sailing.
Of Howsing.
Of Land carriages.
Of Pumps.
Of Mills.
Of Clocks and Clepsydras.[3]

---

[1] It will be observed that there are in fact only 23.

[2] On 1st December 1684 Petty "brought in a paper, *Supellex Philosophica*, containing 40 Instruments requisite to carry on the designs of the Society" (*Minutes of the Dublin Philosophical Society*).

[3] *I.e.*, water clocks.

Of Guns, Powder, and fireworks.
Hydrostatics.
Colorations.
Figurations.
Cloath, Leather, Hats, paper.
Spining, Kniting, weaving.
Meteors and Tides.
Astronomy and Dialls.
Ayre, fier, water.
Ballisticks.
Analysis of the People.
Principall salts.
Chymicall operations.
Metalls, Quick silver.
Glass and Gems.
Fabrick of Animalls.
Synopsis of Diseases.
Botanicks.
Georgicks.
Insects.
Bees, spiders, and silkworms.
To expound the Museum of Gresham Colledge.

* * * *

To be performed in an yeare of 40 weekes.

Each week to consist of 5 dayes, and each day of 3 howers. In all 600 howers.

Let the Collegium consist of 20, under 3 masters, at 20£ per head. The Councill of the Royall Society to bee Sponsores.

No. 86

OF ALGEBRA

(A letter to (?) Sir R. Southwell)

Sir,

You have asked me once or twice what Algebra was. I answered that it was a kind of Logick, and a more refined way of reason upon common and easy principles, by adding and substracting not onely numbers but the several species of things. Also I might have added that the art of adding, substracting, multiplying and dividing of species, with their rootes, powers and proportions, is called the Algorithme[1] of Algebra; and is done by noting the severall species of things by letters or other characters, and by signifying the severall operations of your Algorithme by characters; all which characters or marks are called Symbolls. The principalls whereof are contained in the small table underwritten:

1.	$A=4$	A equalls 4
2.	$A+B$	A added to B
3.	$A-B$	A less by B
4.	$A\,B$ or $A \times B$	A multiplyed by B
5.	$\frac{A}{B}$	A divided by B
6.	$\surd q\,A$	The square root of A
7.	$A\,q$	The square of A
8.	$A:B::C:D$	As A is to B, so C to D

I next propound an easy question to bee answered by Algebra, or a Chayne of argument drawne out of these two common notions onely, vizt:

---

[1] *I.e.*, the method of computing.

(1) Things that are equall to a third thing are equall to one an other.

(2) If equalls be added to equalls the totall will bee equall, and if substracted the remainders will be equall.

Soe have you enough for answering the question following, which is thus stated, vizt:

A thresher thrashed out 40 quarters of wheat and barley. He was to have a shilling for each quarter of wheat, and sixpence for each quarter of barley. At the end of his worke he received 28 shillings for wages.

The question is how many quarters of wheat and how many quarters of barley he had thrashed out?

The first thing to be done is to state the case in symbols, which is done thus, vizt: let W be the marke of the unknowne number of quarters of wheate, and B of the unknowne number of quarters of barley; and because 1 shilling is equall to 2 sixpences, let the number 2 signifye a shilling, and consequently lett 28 shillings be expressed by the number 56, and then the case will be stated in symbolls thus:—

The case & question		(1)	$2W+B=56$
		(2)	$W+B=40$
The chayne and series of argument	$(2)-W$	(3)	$40-W=B$
	$(1)-2W$	(4)	$56-2W=B$
	$(3)=(4)$	(5)	$40-W=56-2W$
	$(5)+W$	(6)	$40-56=W$
	$(6)+W$	(7)	$40+W=56$
	$(7)-40$	(8)	$56-40=W=16$
	$(2)-(8)$	(9)	$40-16-B=24$

Thus have you 9 equations whereof the 2 first are the state of the question, and the 2 last are the answers to the same, and are to be read in words at length, thus:—

(1) Twice the quarters of wheat and the quarters of barley are equall to 56.

(2) The quarters of wheat and quarters of barley are equall to 40. (Qy. How many quarters of wheat and how many quarters of barley?)

(3) 40, less by the quarters of wheat, are equall to the quarters of barley—substracting the quarters of wheat from both sides of the equation.

(4) 56, less by twice the quarters of wheat, are equall to the quarters of barley—substracting twice the quarters of wheat out of each side of the said equation.

(5) Is the 3rd and 4th equation repeated.

(6) 40 equall to 56, less by the quarters of wheat—adding the quarters of wheat to each side of the 5th equation.

(7) 40 and the quarters of wheat, equall to 56—Adding the quarters of wheat to each side of the 6th equation.

(8) 56 less 40, vizt: 16, equall to the quarters of wheat substracting 40 out of 56.

(9) 40 less 16, vizt: 24, equall to the quarters of barley by the 2nd and 8th equations.

Now it may bee here asked how one should know when and what to adde or substract as hath been done?

Answer: That the number of W or B being sought (and because if either bee known, the other is known by easy consequence), the Ingenium of the operation is to pitch upon one of them, as upon B, and then to expresse B by 2 or more equations. Lastly by severall additions or substractions to disentangle the mixtures of numbers with letters, so as numbers onely may stand as one side of the equation, and a single letter or the other, as that $56 - 40 = W$ or 16, and that $40 - 16$ (or 24) $= B$.

By which chayne of argument it appears that of the 40 Quarters of corne, 16 were wheat and 24 barley; and that the Thrasher haveing had 28 shillings of the whole, had 16 shillings for the 16 quarters of wheat and ten shillings of the 24 quarters of barley; in all 28 shillings as was supposed.

Memorandum: That in the foregoing question the Algorithme was simple and the acciomes very few and plain, but yet many intricate questions may be solved even by so much. But where the algorithme is more operose, and where the stock is all the truth in nature that can be expressed in number, weight, and measure, it is not to be imagined what a number and variety of light truths may bee deduced by Algebra.

Memorandum: That as much Algorithme and acciom may be learned and mastered in three months, as will produce the solution of a vast number of importante questions; but the dextrous use and application of the same, soe as to bee free from oversight and Paralegisme, may well require three years study and practice.

This I have written that you may see whether you will ingage your son upon this faculty and way of Logic, as also at what yeare you will begin to put him upon it.

The contents of this Paper are: (1) To tell what Algebra is. (2) What Algorithme is. (3) What symbolls are. (4) To state a question in symbolls. (5) The stock of axiomes and truths. (6) To forme the chayne and series of Argument. (7) To keep an account of each equation in the Margent.

So as in Algebra: (1) The Algorithme is the Tooles. (2) The stock of axiomes as the Materialls. (3) The practice and a good head as the workemanship. (4) The finding out abstruse truths is the work, and out of a few truths to draw out infinite true conc[lusions] and to preserve the method of numbering unconfounded is the exc[ell]ency.

Archimedes had Algebra 1900 yeares ago but concealed it. Diophantus had it in great perfection 1400 yeares since. Vieta, DesCartes, Roberval, Harriot, Pell, Outread, van Schoten and Dr. Wallis, have done much in this last age.[1]

It came out of Arabia by the Moores into Spaine and from thence hither, and W[illiam] P[etty] hath applyed it to other then purely mathematicall matters, viz: to policy by the name of *Politicall Arithmitick*, by reducing many termes of matter to termes of number, weight, and measure, in order to be handled Mathematically. The second, 5th, and 10th Bookes of Euclid, doe make a great parte of the stock above mentioned.

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[1] Diophantus of Alexandria, *fl.* A.D 350; Franciscus Vieta (1540-1603); Descartes (1596-1650); Gilles de Roberval, French Mathematician (1602-1675); Thomas Harriot, published *Artes analyticae praxis* in 1631; John Pell (1610-1685); William Oughtred, author of *Clavis Mathematica*; Franz von Schooten, republished Vieta's works in 1646; John Wallis (1616-1703).

XII

PHILOSOPHICAL

(87) The Scale of Creatures: (*a*) Synopsis, (*b*) The Scale of Animals—(88) On Hobbes' Theory of Monarchy—(89) Fundamental Questions—(90) The Smallest Measure, etc.

PHILOSOPHICAL

THOUGH no admirer of the metaphysical Philosophy of the Middle Ages, which he thought "puzzled poor people with unintelligible Notions" (*London Observations*, Hull, 396), Petty, as a disciple of Hobbes, an original member of the Royal Society, and a reader of Bacon, was an eager follower of the 'New Philosophy' of which Bacon was the founder. His bent was, however, rather towards statistics and economics. He constantly postulated 'terms of number, weight, & measure' for his Political Arithmetic, and was content to leave theoretical speculation to others. Nevertheless, as the following papers will show, he made an occasional excursion into more abstract kinds of enquiry.

His principal effort in this direction was an abortive essay entitled the *Scale of Creatures*. Only fragments of this work remain, but it is not without interest to attempt to reconstitute from them the general drift of Petty's ideas.

The 'Scale of Creatures' was an attempt to establish a line of affinity between God 'the architect of the firmament' and mankind, as also between mankind and the 'smallest maggot,' or lowest form of animal life. The first Petty calls his 'larger' and the second his 'lesser' scale, while in a third or intermediate scale he proposed to classify the gradations between the highest and lowest types of mankind.

The subject is frequently referred to in his correspondence with Southwell. On 30th October 1676 he speaks of a "discourse" recently made which seems to have inspired him with the original idea of his *Scale*. The Discourse in question appears to have been Petty's address to the Royal College of Physicians in Dublin, a draft of which I have found amongst his medical papers and printed *infra* (No. 129). Southwell in reply urges him to put his ideas upon paper. Not long afterwards he sends Southwell (in an undated letter) a synopsis of his intended work, supplemented by four completed chapters, though 'the remainder' he says 'goes heavily on' (*Corr.*, 4th August 1677). Four months later he once more produced a 'review of his materials' (22nd December 1677), but in the following year (20th July 1678) he seems to have become disheartened and to have abandoned the work, which finds no further mention in the Correspondence.

The four finished chapters, which evidently dealt with the 'larger' scale, are no longer extant, but I have printed (No. 87a) the letter to Southwell from which an idea of their subject matter may be gathered. No. 87b, which is endorsed the *Scale of Animals*, as its context shows, was the sequel to these four chapters. It contains part of the 'lesser Scale,' and a beginning of the intermediate Scale which was to classify the various types of the human race. This fragment is, however, evidently both unfinished and uncorrected.

Petty's disabilities of vision prevented him from being a reader of the works of others, and the idea of the 'Scale' was his own and not borrowed elsewhere. It seems that when he discovered that it had been put forward (though in a somewhat different form) both by the Platonists and by Sir Matthew Hale, he became diffident about pursuing the matter further, and eventually dropped it altogether. We might guess that his cautious friend Southwell did not altogether approve of a subject which went so near the debatable and dangerous territory of Religion, and that he destroyed as an incriminating document that part of the essay which Petty had delivered into his hands.

Of the remaining papers in this section, No. 88 is a Latin effusion in criticism of Hobbes' theory of Monarchy (*cf.* Hobbes, *De Cive* (1642), chap. vii, and *Leviathan* (1651), chap. xix, 'Of the several kinds of Commonwealth'). In this Petty takes up the cudgels against his former master in favour of Democracy and suggests a scheme for the popular representation for a *Civitas* of 1,000,000 inhabitants. I have transcribed the document as it stood in the hopes that others may be more successful than I have been in construing Petty's Latin. The general drift of his argument is at any rate sufficiently apparent.

No. 89 is in Petty's favourite vein. It is headed *Fundamental Questions* and propounds (1) Some definitions of measures, actions, and thoughts. (2) A series of questions on the origin and antiquity of religion. To these questions, however, no answers are given.

The calculations in No. 90 are not easy to follow, but they are in part elucidated by some figures on the back of the MS. on which this paper is written. I have explained them as far as I am able to do so in a footnote.

No. 87A

"THE SCALE OF CREATURES" (1677)

(A Letter to Sir Robert Southwell)

Dear Cousin,

I have sped soe well by pretending to say something of the Scale of Creatures, that I have got more from you, then you might reasonably think I could have imparted to you; for I have gotten what the Platonist, and what the more excellent Hales,[1] have said of that matter.

I told you (and truly) that I had never read any thing about it; but I also told you that noe considering man (who syncerly minded the great point) could well overlook it, and consequently I believed that many had already handled the matter better then I could doe. And I now doe with joy see that honest Hales hath said much of my sceme, vizt:

> (1) That, between God and man, there are holy Angells, Created Intelligences, and subtile materiall beings; as there are between man and the lowest animall a multitude of intermediate natures.
>
> (2) That good man inferreth from thence, that man hath noe reason to put soe high a value upon himselfe as if he were chiefe or next to God. Which very notion (as I expressed in my first Letter to you) tended only to humble the proud coxcombd man,
>
> (3) Hales makes an Affinity between mettalls and vegetables, and another between vegetables and animalls, and a third affinity between animals and man, a fourth between man and his subtile materiall being, a fifth between those beings and created Intelligences, a sixth between those Intelligences

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[1] Sir Matthew Hale (1609-1676) in his *Primitive Origination of Mankind*, published in 1677.

and the holy Angells, and another between the Angells and the Creator himselfe.

(4) He saith that the nature of man is very much worth enquiry, because the brightnes of God appeared in the Man Christ Jesus, and because man was made after God's image, and doth faintly resemble God, as the sun in a Bason of water doth the sun in the heavens. Moreover the Platonist saith (i) that between Superior and Inferior species there are midle natures, (ii) that man is a meane between Angells and Beastes or between Intelligent and sencible beings, (iii) and that there is also a meane between inanimate and living natures.

And thus (Deare Cousin) haveing given you to understand that I apprehend the Drift of your two excellent papers, I say that to write of this subject after these great personages, is the same kind of Insolence and Temerity as to paraphrase the 104th Psalme after Buchanan. Neverthelesse, as I have done the one,[1] so I shall doe the other; without any designe of disturbing anything that those worthies have said, but rather with hopes to cleare and exemplify the meaning of such words used by them as are not of a single signification: for the heads of my intended Discourse are these, (vizt):

1. I beg leave of the world to decline the words, Infinite, Eternall, Incomprehensible, when I speake of Almighty God; being words not soe fitt for Ratiocination, but rather for Adoration, and such as beget an honorifick amazment, so as to worke upon our affections, but not to cleare or brighten our understanding. And therefore I mention Almighty God but in part, and only as the maker of the firmament or orbe of the fixed Starrs, and of all things within that Orbe, which is indeed the visible world and the greatest things our senses can reach.

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[1] Petty's paraphrase of the 104th Psalm was published under the title of *Colloquium Davidis cum anima sua* in 1678 (cf. *infra*, p. 285).

2. I make two Scales of animate beings, that is to say, of beings which act by souls. The one whose top is Man, and whose bottom is the smallest and the simplest animall that man can discern; and of the other scale, the maker of the aforementiond visible world is the top and Man the bottome. Nor do I presume to offer at a third scale, but stop here and say *Abyssus abyssum invocat*, or quit it to the sublimer thoughts of others.

3. I demonstrate the vast and immense difference between the said two scales, and doe shew the great multitudes of gradations which are upon the small scale, from thence inferring that there bee many more upon the greater scale.

4. Before I determine that Man is the chiefe and noblest Creature, and worthily the top of the small scale, I doe in termes and words of sence expound what I meane by the words Noble, Chief &c.,[1] and do then by many comparisons show wherein some particular creatures doe excell man; but do withall shew that man doth exceed every creature in soe many other particulars as that he deserveth the preeminence. And in this Chapter I describe both the Powers and Infirmities of man in some variety.

5. Placeing Man on the top of the lower scale, I make many sorts or species of Comparisons between him and his Inferior animalls, downe to the lowest, and presume to infer the like gradations to be in the upper scale.

6. Having proved many gradations to be also in the upper scale, and haveing scripture grounds that Man (part of that scale) beareth the Image of God; I inferr that man is nearer in likeness to the top of the upper scale (which I suppose to be the maker of the firmament, if that maker be anything lesse than the Infinite God himselfe) then to God, concerning whom I doe not presume to ratiocinate at all, but (as I said before) to admire and adore only; fearing to grow

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[1] *Cf.* also Petty's 'Dictionary,' i, p. 150 *supra*.

stark blind by gazing upon him, rather than to discerne him more distinctly by soe doing.

7. I doe not only compare man with the Inferior Creatures of the small scale, but I doe also compare the highest emprovements of mankind in his masse, with the rudest condition that man was ever in; thereby inferring that if man hath improved soe much in the severall past Centuries and ages of the world, how far he might proceed in six thousand yeares more, or in any other number of ages, that is to say how farr he might advance from the bottome (where he now is) towards the top of the great scale.

It may now be expected all this should be applyed to Religion:—as first

1. To prove that there is a God. But this Inquisition I show to be needles, and alsoe dangerous; though not in itselfe, yet in respect of the offense that many may take at speaking of mysterious things in clear words. But I doe much labour to state that question truly and intelligibly, and I hope to doe it soe as may amount to a sattisfactory Determination thereof. So as the principall use of considering these Scales of Creatures, is to lett man see that beneath God there may be millions of beings superior unto man. Wheras Hee generally taketh himselfe to be the chiefe and next to God: (1) because it hath been said of him more than of others that he beareth the Image of God; (2) That God appeared in the shape of man.

Now these two arguments are safely answered thus: first, for that God appeared alsoe in the shape of a Dove, and the spirit of God hath spoken through a more contemned animall; And as to the Image of God, Tis certaine that these creatures must in some sence or sort beare the Image of God which beare the Image of man. Soe that, although the Image of God be more plane upon Man than upon the Inferior animalls of the lesser scale, nothing hinders why the same Image may not be yet more plane upon the superior beings of the greater scale then upon Man himselfe—onely wee must by Image meane figure only.

2. As to Religion, I do in the next place pitch upon two points, which I call the poles, upon which all Religion turneth, and I sett downe alsoe severall powers which make Religion to move upon those two poles. Of which powers some move it steadily, as weights doe a clock; some lesse uniformly, and but as springs doe a watch; others yet more unequally, as streames of water influenced by droughts and land floods doe a mill; and some as irregularly and unequally as vapors and exhalations drive a wind mill. As for other opinions which do not turn upon those two poles of religion; they move but like chaffe and feathers driven to and fro, upwards and downwards by every puffe of wind, and by the vapors of distempered blood, humors, and spiritts. And thus I have epitomized what you have sent me, and what I intend to send to you, as soon as I can calmely review it—all of which you see to bee the same that others have and must think of.

(*Endorsed.* "Sir Wm. Petty's Scale of Creatures": no date.)

No. 87B

The Scale of Animals (a fragment)

Wee have shown that the space betweene the Globe of the Earth & the firmament is very vast and wee have propounded that in the Scale of Animalls living upon the Earth there are many Stations, divisions or gradations, although that Scale be very short; and consequently wee would inferr from thence that the vast space aforementioned cannot bee without some divisions and gradations likewise, and consisting of middle beings having some kind of affinity or analogy with both extreames; that is to say with Man which wee make the low end of this new larger Scale, and the Artichect of the firmament which wee make the upper end of the same. Now to the end wee may the better guess at the parts and gradations of this larger Scale, wee shall in this ensuing Chapter sett doune our Observations concerning the divisions and gradations of the lesser Scale of Animalls, the Upper end whereof wee make to bee man, and the lower end, the smalest worm or Magott that our sences can take notice of.

And wee shall also add another Scale containing the Severall Stepps and gradations of improuvements which man hath made from the lowest and simplest condition that mankind was ever in, unto the highest that anie man or Company of men hath attained; unto the end that wee may thereby guess unto what higher degree and pitch of knowledge man may in length of time arrive. That is to say that wee may guess the meanes and probabilities of communication or conversation that may be had and made between man, the topp of the Lower Scale, & the severall Members and graduats of the Upper Scale; wherein for our incouragement wee shall show, that it is not more difficult for some men to find the passage from the Globe of the Earth unto the bodies of the other planetts, than it is now for some men to find the way from the Island of Ireland to that of Scotland and from that of Ireland to the Barmudoes, with severall other instances of the like nature.

As to the description of the lesser Scale (whereof man is the topp and the smallest Magott the bottom) wee say as follows:—

1. Man being the first or Topp of this Scale, the question is what Animall shall bee next. Unto which question, because no certain Answer can bee given, wee shall substitute probable Hypothesis instead of

them, being contented to bee confuted or excelled by any who shall propound what is more probable, simetricall and congruous, than what we shall at present offer; reserving to myself the same liberty of endeavouring to improuve this first draught or Minnitte of an extraordinary Scheme. I therefore propound an Elephant for the next Creature in dignity to a Man, not because of his great strength (which is equall to the strength of Man assisted by Levers & Sences & Wheels) but rather because of his wonderfull Dexterity ariseing from the various & multiform use & Application of his probossis, which in many cases equalls, & in some exceeds thouse of a man's hand.

2. I give him the 2d. place for his Memory & understanding, which I have heard extende to the greatest use of the Language of those Men with whom he converses, being a faculty not soe eminent in any other Animall. Moreover since Longevity, or living till 80 or 90 years of age, doth accompany the dexterity, memory & intellect above mentioned, it seems to mee that the said Qualifications together with his great strength for Execution, doth give him a fair pretence to the next place in the Scale after Man.

3. In the Opinion of most men, the Ape or rather the Drill (which is the largest & most manlike species of Apes) should claim the 2d. place unto which we have preferred the Elephant, 1st. because his shape is far neerer to that of Man, than any other Animall's is, and for that his Actions as they have been reported by those who pretend to know them do in many points resemble those of a Man. Nevertheless [since] it be true that an Elephant can understand the language better then a Drill, and that the *Mens* of an Elephant doth come neerer the *Mens* of a man, although the shape of a Drill comes neerer the shape of a man, I shall choose (as I have done) to give preference unto the Elephant.

Speech is more peculiar unto, and copious in a Man than in any other Animall, and consequently wee might in that respect give the 2d. place to Parrots, or that species of them, in which the formation of Articular sounds and the imitation of Man's Speech is most conspicuous. Nor is an Ape so considerable to mee for imitating the externall & visible motions of the parts & Organs of a Man, as speaking Birds are for imitating, by a sort of reason & internall sence, the motion of the hidden and unseen instruments of speech, which are the Muscelle of the Lungs & Larynx. But it is plain that although Parrotts do pronounce words, that they do it but as sounds, and not like men, as the signs of things, Actions & Notions; & consequently this faculty of speaking birds extending onely to sounds & not to the Conceptions of the Mind, I think it not sufficient for degrading the Elephant from the second place in the Scale, & serves onely to give the Parrott a pretence to contest with the Ape for precedency.

4. Haveing admitted the Parrott to a right or Competition, I will not exclude the Bee, referring you to what Virgil and many observant Men have seriously and experimentally, not vainly or fabulously, spoaken of them; and among all the admirable operations of the Bee, I preferr his pollicy, assigning that faculty for the thing wherein hee comes neerest to Man. And pollicy or the Art of Government seems to bee the most considerable faculty of a Man. For how wonderfull is it, that the spiritt of one Generall of an Army should influence, consimulate & semitrize the Minde, manner and Motions of 40000 men, or rather that one Monarch should consenture and draw together the Mentall & Corporall Facultyes of 10 Millions of Men,—as Burning Glasses do gather & converge many thousand Beams of the Sun into one focus or burning point, so as to excite a heate that shall melt silver, where without such burning glass the same raise of the sun would bee too weak to cinge tinder. I say that if what is reported concerning the pollicy and Government of Bees, be true,—con-

sidering how little while they live, and either how much knowledge is conjoint with them, or how much they learn in a Small time, as also what Art is visible in the Makeing of their honycombe,—I say their Souls seem as like the Souls of men as their bodies are unlike.

What I have said concerning the smalle Animall the Bee, may be easily turned into Ridicule, because the Bee is so smale an Animall. But lett it bee rememberd; 1st, that so much canot be said for the Whale as is comonly written of the Bee. 2dly, that Animalls by how much they are lesser, by so much are stronger; as vulgar experience, as well as Mathematicall reason, do show Us. Nor do I doubt if the most powerfull Armies ever heere upon Earth are a sort of Soldiers who for their smallness are not visible. For there is no better Hypothesis whereby to make out the destructions of so many thousand men in a season by the disease called the plague, than by imagineing the same to bee done by Millions of invisible Animalls that travell from Country to Country,[1] even out of Africa into England, and do fall on, and draw back so on a day, as seemes to be the effort of some comon intellect that commands them upon the whole Matter. Vastness of body is nothing, for as I said before, wee doe not heare of greater Acts of Intellect to be in Whales then in Bees, Spiders, & Pismires, nor is it improbable that by how much their body is smaller by so much the soul is greater. For we see the small birds have more prospective and farther seeing Eyes then Men, & that our Telliscopes work further in proportion as they are longer. Wherefore the excellency of vission in small Animalls above that of Men and greater Animalls, must be attributed to the greater strength & activity of their Soules; the Soules of the smaller Animalls being as much abler for perception as Bell mettle is then spung for executing of sounds.

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[1] So Petty was already seized of the 'germ' theory.

Wee have hithertoo discoursed whether the Elephant, Drill, Parrott or Bee shall have the 2d. place in the scale, and we have given it in respect of Shape to the Drill, in respect of Sounde to the Parrott, in respect of Memory & understanding language to the Elephant, but in respect of the spirituality and power to the poor Bee. But wee shall hereafter more confine ourselves to ranck and Marshall the Creatures in the Scale by their likeness in shape and visible appearence, rather than by the Objects of other Sences, or internall operations of the soule, not omitting the differences & gradations which are sensibly discoverable in the said objects of other sences then that of sight.

As an Appendix to this first part of our discourse upon the Scale of Creatures, wee add the following Observations (Vizt):

1st. That of man itself there seems to bee severall species, To say nothing of Gyants & Pigmyes or of that sort of small men who have little speech and feed cheifly upon Fish called Uries.[1] For of these sorts of men, I venture to say nothing, but that 'tis very possible there may be Races and generations of such; since wee know that there are men of 7 foot high & others but four foote, that is to say, the one a foote and a half above, & the other a foot & a half below the middle stature of mankind which I take to bee 5 foot & a half. I say there may bee Races and generations of such Men, whereof wee know the individualls; as wee see vast differences in the Magnitude of severall other Animalls which bear the same name,—as between the Irish wolf Dogg and the Bullonian Tumbler & the Iceland Shock; and in horses between the large ones of Flanders & the Hobbies of some other Countrys, between the Muscovia Ducks & the Ducks of these parts; I might say between Ratts and Mice &c. So as the difference in bulk and weight between a man of 7 foot high & him of 4 foote, is neere as 5 to one. And what difference is between the Bulke of one Man & another, seemes to mee, to bee also in their Memories, Witts, Judgments & withall in their externall Sences; some being able to see, others to heer, & others to Smell 5 times as farr as other individualls of the same Species. Nor doe I doubt, but do rather affirm to have observed, the same differences even in the Memories & intellects of severall brute Creatures, such as Hunters do take Notice of in their hounds, and as is easily observable in horses.

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[1] ? *Aericae*, 'River fish which feed on flesh and have lice under their fins' (Cockeram's Dictionary, 1650), or *Uriae*, but these are birds (divers) not fish.

Besides those differences between Man & man, there bee others more considerable, that is, between the Guiny Negros & the Middle Europeans; & of Negros between those of Guiny and those who live about the Cape of Good Hope, which last are the Most beastlike of all the Souls [? Sorts] of Men with whom our Travellers are well acquainted. I say that the Europeans do not onely differ from the aforementioned Africans in Collour, which is as much as white differs from black, but also in their Haire which differs as much as a straight line differs from a Circle; but they differ also in the shape of their Noses, Lipps and cheek bones, as also in the very outline of their faces & the Mould of their skulls. They differ also in their Naturall Manners, & in the internall Qualities of their Minds.

It is likewise observed, that the people who live in the Northermost parts of the Habitable world & even the Lapplanders (then which severall do live more Northerly) are a very mean Sort of Men, both in their Statures and understanding, and do excell other Men onely in the faculties of fish, as in Swiming, diving &c.

The next Observation is that men Themselves, even of the same Nation, are distinguishable from each other by their resemblance (faint or strong) which most Men have to some brute or other. Which resemblance the Italians call *Carrigatura*, for who hath not seen the spiritt of a hawk in some men of bright clear eyes with high adunc[1] Noses; the shape of a ffox in Men of Globose foreheads & cheeks, with sharpe Chins & Noses; the shape of an Ox in Men with Noses broad & flatt between the Brows; the shape of a Lyon in the cheek bones Nose & Lipps of some men; the shape of a Goate in the Outline & Noses of some faces. And it is also observed that such Men in which those Resemblances & *Carrigaturas* are strong & plain, do partake in some measure with the same Brutes as to their internall Qualities of Physiognomy, or rather of Metoscopy.[2]

Wee have hitherto spoken of the differences of men and of their various resemblances with various Brutes, and have placed the Drill next in the Scale below Man as to shape & Actions; The Elephant as to the understanding of language, Longevity & Dexterity; The Parrott as to the pronouncing of Articular Sounds & the Bee as to Mechanic prudence & pollicy. The end of what wee have said & what wee doe intend to say in this whole Matter, being still to show,—that there are beings within the Concave of the firmament or Orb of the fixed Starrs (which is our visible world), beings which do incomparably excell Man in the sense of dignity and infirmity, (described in the 3rd & 4th Chapters of these Treatises[3]) then man doth excell the vilest in sight [? insect] wee know, & such being of man as little understanding as the said vilest in sense [? insects] do understand him. And consequently that Man is concerned to have a fear of those invisible powers, which are so much more mighty than himself; & consequently most of all of God, who is the Abysse of all powers, and of whom for that reason we do not presume to speak in this Treatise, onely for fear of loosing our selves by endeavouring to comprehend what wee do find incomprehensible.

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[1] *I.e.*, hooked (Latin, *ad-uncus*).

[2] Metoposcopy—the means of judging a man's character from his face (*cf.* G. A. Borelli, *De motu animalium*).

[3] This reference seems to indicate that the present paper was the 5th chapter of Petty's projected *Scale of Creatures*.

Now as a Boat, which aimeth at some good Port with a bare Wind, cannott go directly to such Port, but must purchase towards it by many breakers & oblique Cources and tacking, & some times must help itself against the powers of the Wind by his Oars, & sometimes (when neither wind nor Oars will gett her ahead) must hinder her going astern by her Anchors—So I am forced, in order to arrive to the aforementioned Port of demonstrating the reason of Religion, haveing made one board towards it by Nominating 4 severall Seconds to Man in likeness, I am just now tacking t'other way by setting down the various dissimilitudes of the Creatures from Man & one from another, by saying as followeth:

That Man in his Motion or Gression goeth with his Length or greatest Demention perpendicular to the ground, whereas all other Creatures go with their Length parrallel to the same, As worms chiefly & all Creeping things. Fish, also in their direct progressions Swim so, & tis [un]likely that in their Motions from the bottom to the Topp of the Water, their lengths make to the ground a sharper Angle than 45 degrees (or half the Quadrant) & the like position wee may observe in the flying of Birds upwards, never riseing (or very little) perpendicularly but in angles more or less sharp with the Horrizon.

The skin of Man hath very little covering, but other Animalls are covered with haire, wooll, feather, scales, Shelle, or Brisles, all differing very variously from each other. As for Example the hair of Shocks & Spanniells differ from the hair of grayhounds & other sorts of Doggs, & the hair of Doggs differs from that of Camells, bears, foxes, Badgers and all sorts of furrs. The Wooll of Sheep from that of Beavers, Hares, Coneys, Catts. Nor are the Collours of the hairs of severall Animalls alike, few horses or Doggs being of the same Collour with Red Cows, nor vice versa. Nay the Collors of white & black are not of the same sorts of white and black, some blacks drawing to yellow in some degrees, some to red & som to blew; which varietys also are in the Collour White, & indeed in all Collours. Concerning the Collours of feathers they are infinit & are wonderfully numberd in one or the selfsame Bird, & one or the selfsame ffeather.

Man canot move or run so swift as some Horses, Doggs, Hares &c., but 'tis believed that a man travelling 40 days together, can go a longer way than either of the said Animalls.

Man supporth a greater waight upon less footing, than any other sort of Animall. That is to say a Quadrangular figure whereof Man's two feet are two sides and the Lyne fro Toe to Toe & heel to heel are tother two sides, incompasseth less ground then the like Quadrangular figure made of the distances from the two fore feet & the two hind feet, & the distances between the fore & the hind foot of each side, in four footed Creatures.

A man will grow to a great fattness, that is to say, untill his fatt bee equall to the weight of all his bones (in which Relation I state the Proportions of fattness) but will neither grow so fatt as many other Animalls, much less will hee fatten in soe short a time by any Art that can bee used. For a Hogg, the Trunck of who's body is as bigg as a Man's, shall bee made exceeding fatt in 6 Weeks, such as Man seldom reacheth to in 6 yeares. Such Animalls will become lean proportionably, and of some Animalls it is said that they will be fatt in 24 hours.

No. 88

ON HOBBES' THEORY OF MONARCHY

Clarissimus Hobbius qui eorum quae tractat omnium naturam penitissimi scrutari solet, mihi quidèm aliquanto seciùs agere videtur, ubi de commodis et incommodis Monarchiae agit, eadem in iisdem in Democratiâ comparando.

Nam prima quam agitat quaestio est, utrùm Monarcha plus ditare suos filios cognatos, aliosque gratiosos ex Republica possit et solet, quàm oratores in Democratiâ.

2. [questio] est, utrùm homines innocentes plus ac saepius punientur imò capite plectuntur ab Monarcha quam à populo imperante.

3. An cives plus habeant libertatis (quam is optime explicat, esse paucitatem legum, vetitorum, et impedimentorum) in hoc vel illo statu.

4. Quaeritur an Senatores vel Consiliarii plus habeant, in quo doleant gaudeant vè, dum in magnis cœtibus, quam dum paucorum conciliabulo orant agantque.

5. Utrum res arduae civitatis tutiùs, rectiùs, tempestivius, atque expeditius, decernantur a multis quam a paucis.

Denique vir ille clarissimus, post illas omnes quaestiones accordo et pro magnitudine sui ingenii discussor, tandem prefert Monarchiam Democratiâ, quià democratici suos exercitus, id est maximi Monarchi negotia, Monarchae gubernent, unum castrensem ducem militibus militum praeficientes.

Attamen utrumque principalis quaestio determinari debet. Liceat mihi dicere, determinationem illam, ab illis familiaribus quas supra recensui quaestionibus non pendere at potius est his sequentibus, vizt:

(1) An liqueat ab historiis praeteritis quod Democratiæ quam Monarchiae diuturnius persisterunt;

nec internis desidiis, nec ab externæ vi, fractae vel solutae?

(2) Utrùm cives opulentiores, tam in universo quam in particularibus, esse solent? Utrùm rarius fame ac egestate pereant, in militiam mercenariam preposiatur, novas Colonias petant? Necnon saepius obfurta fraudes et latricinia plectantur, Monarcha quam populo imperante?

Utrùm artes mechanicae magis hic vel illic floreant? aut inventa utilia hic vel illic sunt frequentiora?

(3) Utrum idem civium numerus plus possit aut in militia, tam defensiva quàm offensivâ, Monarchae vel Democratiae instructus.

(4) Utrum aequalis numerus parentum uteriorem prolem in eodem, sive in aequali, tempore pariat? Porrò utrum plures accedunt quam discedunt civitate?

(5) An dulcius est humanae Naturae permultos suam potestatem in unum quemdam et in perpetuum transferre, id est pendis amittere, quam ipsopuel deindem servare, vel paulatim et in breve tempus irogare, a seipsis demò reformendam et disponendam alioquin pro ut, mutato tam rerum quam animi indies suaserit?

(6) An imperante universo populo, omne genus Ministerii (scilicet per unum vel paucos, ubi res cito et secretò sunt agendae) non aequè adhibeatur ut in ipsa Monarchia. Pono utrum prudentiores Monarchae (imo fere omnes ex necesitate naturae) non cogentur coetus multorum hominum convocare ad leges de multis, et ad multos spectantes ferendum.

Denique utrùm unus quilibet (arte rerum non a natura praestantissimus) possit monarchein aut ipse tutum esset, id si possit facere.

Postremo; utrum puer stolidus, demens, libidinosus, delirus, tanto oneri par esse soleat, ita ut nunquam sit ulla necessitas democratiae agendi. Ideoque, an non melius fuerit illis mediis semper uti, ad quae aliquando et sagissime confugere necessare fuit praevidemus.

Verum antequàm ulla quaestionum damùs dictarum ventilari recte possit, oportet ponamus sequentia, vizt:

(1) Pono numerum Civitatum, scilicet adultorum et infantorum utriusque sexus, majorem esse quàm qui ab uno quopiam homine cognosci queat. Puta sex milliones.

(2) Pono ex 6 millionibus, verum esse millionem Magentyorum[1] 18 annos natorum, qui in totidem domibus sive familiis degent; penes quos Magentos tota vis civitatis est, quippè qui habent dominiam in minoris aetatis omnes et in foeminas majoris, quae sunt vel matres, uxores, sorores filiae, vel amasiae[2] Magentorum suprà dictorum.

(3) Pono Magentos 18 annorum posse militare, generare, artem quamlibet exercere, religionis rebus praestare et consulere de Rebus Publicas.

Unde quaestio est utrum potestas in 6 milliones commodius inesse poterit in unico millioni Magentorum, 18 annos natores, an in unico quoniam homine. In illis ad tempus quoddam breve, aut in hoc in perpetum. In illis intrà anni spatium resumenda, in hoc irrevocabilis.

(4) Pono quod tantus numerus quantus est millio hominum non potest à qualibet uno medium a paucis cognosci. Ideoque quod Methodus quœdam illis recte gubernendis adhibenda est nonsens ac memorandis tot rebus (quot Metusalen (?) hominis memoriam super est) ad libitum producendis. Qua poster experientia et consuetudine edoctus pono, totam illam multitudinem primo dividi posse in viciniàs Centum virorum, sive in 10 Millia Centumviralum. Deinde quod ex 10 Centumviralibus Chiliarcham fieri; ex decem Chiliarchys, vel ex 100 Centumviralibus, Comitatum conflari; ex 10 Comitatus Provinciam;

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[1] Men of eighteen years of age = majores.

[2] Sweethearts.

ex 10 Provinciis sive ex 100 Comitatus esse totam Civitatem.[1]

Ratio autem quarè per numeros denarios ita agatur, quam suo nulla est praeterquam, quod per talem articulos in arithmetica agatur, et quod ista divisio olim in aliis dynastis faciliter adhibita fuerit, et quod nullis aliis numerus manifestò commodior profereratur.

His positis, pono insuper Ministros[2] ad minimum 10,000 eligi debere ad Centumvirales, 1000 ad Chiliarchias, 100 ad Comitatus, 10 ad Provincias. Dico ad minimum, nam quilibet Centumviralis, Chiliarchia, Comitatus et Provincia possunt plures uno Ministros postulare. Unde liquet numerum Ministrium ad minimum erit 11110,[3] forsan ex illo numero dupliceto, triplicito &c.

Qua propter proxima quaestio est: Utrum 11110 Ministri eligendi ab uno quopiam, vel ab illos quos ille unus ad talem electionem ordinetum sufficerit, scilicet incipiendo ab electione decem per unum, quorum 10 singuli 10[4] alios, et sic deinceps ad quartum usque seriem progrediendo. Vel vice versa, an Centumviri unum, an illorum virorum 10, eligent Chiliarcham vel Chyliarchas, 10 Chilarchae comitem, 10 Comites Provincialem, 10 Provinciales Imperatorem generalem.

Quaestio nunquam est: utrum 100 homines possunt rectius de uno judicare, quam unus de 100, et sic de

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[1] Thus 100 Magenti (adult males) = 1 Centum Viralis.
10 Centum Virales = 1 Chiliarchy (χιλιαρχος).
10 Chiliarchies = 1 Comitatus.
10 Comitatus = 1 Provincia.
10 Provinciae = the Civitas (or State of 1,000,000 men).

[2] ? Ministers or priests.

[3] *E.g., elected by:*

Centumvirales	10,000
Chiliarchies	1,000
Comitatus	100
Provinciae	10
Total	11,110

[4] *Sic*, but is not 100 intended?

caeteris electionibus. Nec non an electio tempestiva, puto annua, quo 100 eligent unum ad annum, potior est eâ qua unus eligit centum in perpetuum, quorum quilibet eligit centum alios, ac sic deinceps. Ita ut secunda electio plane differet a mente primorum electorum, uno et tertia a secunda, tandem tertia a quarta, quarta a quinta. Ita ut prima electio a quinta tantum distat quanta distare an differre naturà possit. Una quaeque id est totus ut agat Cœtio.[1]

Rursus, posito quod existant 100 aliqui homines qui recte gubernari vellent, quaestio est: Utrum a centum unus sit sorte inveniendus qui eliget gubernatorem, an ille gubernator eligendus sit suffragio omnium Centumvirorum.

No. 89

FUNDAMENTALL QUESTIONS

1. What is a Common Measure of Time, Space, Weight, & Motion?

2. What is the greatest & least Body in Things & Number? [2]

3. What sounds will represent & Expresse the premises.

4. What number of Elementall sounds or letters, will compasse all the last mentiond sounds or names, and make a speech or language?

5. Names of Things & their qualities, as also of all motions &c. Actions, with the conjunction of them, are the Essentiall parts of speech; There be others auxiliary.[3]

6. How letters or Elementall sounds may bee made characters, and how (with the smallest length of line in these characters) to expresse the same sound; which is Writing.

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[1] ? Coetus, an assemblage.

[2] For Petty's answer to this question see next paper.

[3] *Cf.* Hobbes, On the origin of Speech (*Leviathan*, chap. iv).

7. How to make great Numbers of Coppies of any writing; which is Printing.

8. How to give names to names, and how to adde and substract *sensata*, & to ballance the weight and power of words; which is Logick & reason.

9. How to make speech which excites passions & begets beliefe; which is Rhetorick. As to do the same by sounds is Musick, and by motions of the Body is Dancing.

10. How to move laughter.

The Second Chapter

Having the knowledge of measures & speech, enquire:

1. How many yeares old is the first writing wee can find? What other former writings it doth mention? In what language the same is? In what part of the earth the same was written? By whom?

2. Whether many species of Man were made at or about the same time, and when and where was each made?—How many there be now of each? To what yeares they live, (in particular or at a medium) in the severall ages & parts of the Earth—In what proportions they dye, according to their severall ages & sexes & habitations? What number of yeares males & females are prolifick? What rules of Marriage are best for procreation?

3. How ancient & large is the opinion of One God, of Angells, of a Devill, of Soules distinct from bodies, of the Immortality of the Soule, of their subsisting in paine or pleasure without the body? By whom, when, & where set up?

4. What are the sevrall religions now in the World? By whom, when, and where was each introduced? What other religions have there been in the severall ages & Contryes of the World? How did they come in & go out?

5. How hath the Globe of the Earth been divided into Soveraintyes for the 30 last centuryes of the

World, & under what formes & species of government? What is the weight & power of each at this day; in People, wealth, territory, shipping, armes, mony, reputation, duration &c.?

6. What [are the] lawes of all Nations, of the 4 Empires or Monarchyes, of the Churches & religion, of 4 or 5 greatest present States?

7. What authentic Bookes are there written in the first 60 yeares after the birth of Jesus of Nazareth? that is to say by men who might have been 20 yeares old at his birth, and above 50 at his Ascension, & had 30 yeares after to learne the truth of what they saw & had heard from others. Where are such bookes now kept?

8. How many bookes, like those of the 4 gospells & Acts of the Apostles, were there written in the said first 60 yeares? What is become of the rest? When, where, & by what authority were the 4 gospells made Canonicall? In whose hands are the oldest copies of them? The same may be asked concerning the Epistles of St. Paul & the rest of the bookes called The New Testament; and when and how were all the bookes, both of the Old & New Testament, brought into one comon [book] & made Law?

9. Did any one Person (& particularly the Bishop of Rome) before any Temporall soveraign (& particularly the Roman Emperor) became Christian, governe all Christians—whose subjects soever they were, vizt:

(i) Tell them what scriptures they should receive for the Law & Will of God.

(ii) What doctrines they should believe & professe.

(iii) By what forme of government Their severall congregations should bee ruled.

(iv) What formes of prayer, in what times & places, with what sacrament & Ceremonyes they should worship God.

(v) How the Countryes should be divided into Provinces, dioceses & parishes.

(vi) How by Glebes, Tythes & otherwise, Ecclesiastics should be mantayned.

(vii) What Jurisdiction, offices & praemunires (?) they should have &c. & how were such comands of that one Universall Bishop consist[ent] with the rights & powers of the severall soveraines whose subjects the Christians were?

No. 90

OF THE SMALLEST MEASURE. THE VISIBLE WORLD. TOUCHSTONE OF GEOMETRY. THE GREATEST PROPORTIONABLE MAN

Let $\frac{1}{1000}$ part of an inch bee the smallest line that can bee discernd by the best eye, through the best microscope.

Let 1 inch of a degree bee the smallest angle that any art or instrument can measure.

Let the Earth bee 360 degrees in circumference, of 69 English miles to each degree.

Then the Diameter of a circle, in which the chord of an Arch of 1 inch is about 8000 miles, will bee about 250,000 millions of millions of Points; and the sphaere whereof the said line is the diameter, will bee about 1-52 cyphers, or a number of 53 places.[1]

A greater number then what is expressible by 53 places is uselesse: Nor is there a longer line than the diameter above mentioned; nor a smaller angle; nor a smaller Line.

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[1] The method of Petty's reasoning seems to be thus: He assumes the Earth, with a diameter of about 8,000 miles, to represent the 'chord' subtending an angle of 1 inch (or the 360th part of a degree) at the centre of its orbit. He multiplies this chord of 8,000 miles by 60 × 60 × 360, thus getting 10,368,000,000 miles for the circumference of the circle (or orbit) of the Earth round the sun. He then divides this figure by $3\frac{1}{8}$, to obtain the diameter of his circle (3,888,000,000 miles), and he reduces the miles to 1000ths of an inch, thus arriving at a figure of approximately 250,000,000,000,000,000, which represents his 'longest line' expressed in terms of his 'smallest measure.' I cannot, however, explain how he purports to get from this diameter a spherical measurement running into fifty-three cyphers.

Memorandum. That a man bearing the same proportion to the Great Orbe as a man of 6 foot high doth to the Earth, would bee about 600 miles tall—whose eye would bee about 9 miles from corner to corner and his hayres about one furlong through.

Memorandum. That if the Quadration of the Circle, diameter of a square or doubling the Cube, bee done within $\frac{1}{19\ \text{places}}$, tis enough. That being the number of the smallest visible measures with the longest line in the whole visible world.

XIII

MULTIPLICATION OF MANKIND

(91) Concerning Marriages—(92) Of Marriages, etc.—(93) Californian Marriages with the reasons thereof—(94) About the Encrease of Mankind—(95) On Doubling the People 1687—(96) Cogitata de Connubiis.

MULTIPLICATION OF MANKIND

"FEWNESS of people is real poverty, and a nation wherein are eight millions of people, are more than twice as rich as the same scope of Land wherein are but four. For the same Governors, which are the great charge, may serve near as well for the greater as the lesser number."

So wrote Petty in his *Treatise of Taxes* (Hull, 34), while later on in the same essay he enunciates the dictum that "Labour is the Father and active principle of Wealth, as Lands are the Mother" (Hull, 68; *cf.* also *Observations on the London Bills of Mortality*, 377).

Hull suggests (Introduction, lxxi) that Petty did not originate this idea of the 'value of the people'; he was at all events the first to apply it in his calculations, in which it is always included.

Land was in Petty's time almost the only form of capital, and labour was, generally speaking (more especially in Ireland and in the new American colonies), insufficient to secure its full development. The equation of 'Lands & Hands' being thus a cardinal object in Petty's system of Political Economy, his thoughts turned towards the Multiplication of Mankind as a means to that end.

In August 1685 he sent Southwell a paper on this 'desideratum,' which he 'takes to be equall to all the projects which have been these many years for the advantage of the world' (*Corr.*, 29th August 1685). This produced a long epistolary discussion between the two friends. Southwell considered that Petty treated the matter too lightly 'as it were the putting of a dozen of eggs under a hen' (*ibid.*, 5th September), and that it would lead to a 'superfoetation of mankind.' Petty, however, with characteristic determination maintained his point, citing the divine command to 'increase & multiply' and refusing to admit that the earth could be overpeopled for 1000 years.

A few months later (25th November 1685) Petty wrote that he was thinking of publishing his *Essay for Multiplication* adorned with Southwell's animadversions, and in the following year there appeared a pamphlet with the title *An Essay* *concerning the multiplication of mankind, together with another essay in Political Arithmetic concerning the growth of the City of London.* The second portion of this was merely a reprint of a tract which had been published two years before. But the publisher explains that the *multiplication* essay could not be found at the moment of going to press, and in lieu of it he inserts an extract from one of Petty's letters in which its heads only are given (Hull, 444-445). At the end of the pamphlet there is a 'Postscript' in which Petty (excusing himself from apparent irrelevancy) gives some "Considerations of the time when the whole world will be fully peopled, and how to justify the Scriptures concerning the number of Quick & Dead that may rise at the Last Day &c."

The first four papers published in this section (Nos. 91 to 94) are evidently subsidiary to this lost essay on *Multiplication.* They are concerned rather with the means of putting Petty's plan into practice, than with its justification in theory, and were no doubt written while he was in the midst of his arguments with Southwell.

It would be interesting to trace to its source the story of the "Californian marriages" which forms the basis of Petty's paper on that subject (No. 92). The name of California had been given to the unknown North West in the middle of the sixteenth century, but for a hundred and fifty years afterwards this region remained unsettled and unexplored, and, as the maps of the period show it, was believed to be an island or a group of islands (*cf. Some imaginary California Geography*, H. R. Wagner). It was not till 1697 that the first Jesuit missionaries penetrated into the Lower California of to-day, nor till fifty or sixty years later, when the Missions became firmly established, that the Spanish government began to take an administrative interest in the territory thus opened up. Petty perhaps uses the term as applying generally to the western seaboard, and the curious customs to which he refers may have been prevalent amongst some of the Indian tribes in that part of North America. Marriage laws in the European sense were, of course, non-existent amongst these Indians, and we are told that the early missionaries were quick to notice and approve any conventional rules in restraint of promiscuous intercourse between the sexes (Parkman, *Jesuits in North America*, 21). Some such report had apparently reached Petty's ears, and 'Californian marriages' proved a convenient peg on which to hang a characteristic dissertation on his favourite topic.

No. 94, *On Doubling the People,* is of later date. The estimates given therein of the value of People, Land, and Housing differ considerably from those in No. 80 (i, 264-5 *supra*), though both were apparently written in the same year (1687). The latter paper was intended for the King, while the former was written only for Southwell's eye, as a final effort to convince him of the value of ' multiplication.' With this object Petty seeks to demonstrate that if the population of the British Isles were doubled, the value of the land and personal property would automatically increase by more than 1600 million pounds. He was, however, afterwards compelled to admit that this was ' the most extravagant paper he ever wrote ' (*Corr.*, 6th September 1687).

The last paper, *Cogitata de Connubiis* (No. 96), is in the same vein as those which precede it and gives, in discreet Latin, Petty's plan for the procreation of the maximum number of children. It may be noted that this was one of the ' tractatiuncli ' which Aubrey specially mentions when speaking of the unpublished material which he had seen in Petty's ' closet ' shortly after his death (*Brief Lives*, 1898, vol. ii, 146).

No. 91

CONCERNING MARRIAGES

1. The first command of God was to encrease and multiply. Wherefore the law for marriages is that which will cause the most encrease of people.

2. The way of marriage is now such, that of 100 capable women only 32 are maryed, and these 32 brought 11 children per annum. Whereas 100 teeming women may well bring 40 children per annum.

Wherefore:

(1) Let it be no sin or shame for a woman to bring a child.

(2) Let there be places for women to lye down in.

(3) For keeping the child.

(4) Let there be a tax upon all men of between 18 and 60, and upon all women of between 15 and 45, to defray the said charges of lying in and nursing; and the tax on the women but half that of the men.

Over and above this general proposition; Let no woman, upon payne of being counted an whore, admitt any man without an indenture of covenants concerning (1) the time of cohabitation, (2) the allowance to the woman, (3) the disposal of the children and the power of inheritance, portion (?), name &c.

No. 92

Of Marriages &c.[1]

1. That none copulate without a covenant.
2. That no youth under 18, and girle under 16, meddle with each other.
3. That such (shall) produce a child once in 3 yeares whilst they are teeming, under a penalty; except in case of sickness, loathsomness &c.
4. That a covenant may bee disolved in 6 monthes, in case of no conception, to be provd by proper signes; otherwise to continue till the delivery of the woman.
5. That every woman between 18 and 45 pay an half penny per diem, and every man between 18 and 60 pay a penny per diem to the publicq.
6. That 50*s*. per annum bee allowd for keeping a child till full 7 yeares old, and 20*s*. for a woman lying in, to the publicq places or to each woman herselfe in particular.
7. That at 7 yeares old the children bee disposed for 14 yeares after, and bee then free, having been taught some Trade.
8. That every man and woman have a livelyhood *ut alibi*.

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[1] The context shows that this was written as applying to Ireland.

9. That a woman is not bound to declare the father, but to the officer who was privy to the contract and *habet sub sigillo.*

10. That this liberty for short marriages do not take away the present way, nor other covenants of cohabitation, estate, rewards &c.

11. That both parties shall sweare they [are] free from any fowle disease.

12. That if either parent bee Protestant, the child shall be such; and the child that shall come into the hospitall, or the child of the mother who shall lye in in the comon house, shall be a Protestant.

13. When Ireland hath above 5 millions of people, that this liberty may cease.

14. Women of above 45 yeares old may not use men, unlesse all under 45 be provided with men.

15. *Q.* Whether the parents of hospitall children shall be connected absolutely or in part?

16. None under covenant shall meddle with another.

17. English Protestant women shall bee exchanged for others, when the cabbins are reformed.

18. Incest shall extend but[1] to mother, daughter, and sister.

19. Women that can produce 3 children in 3 yeares shall have —— reward, for 10 children ——, for 15 children ——, and —— for 20, out of the public stock.[2]

20. The hospitall children to bee bred up without sucking, or with very little in speciall cases.

21. A method is to bee set down for the diett, clothes and lodging of the hospitall children and of their breeding.

22. The same for the women who lye in the publicq houses.

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[1] *I.e.*, only.

[2] The rewards for prolific mothers are left blank in the original.

No. 93

CALIFORNIAN MARRIAGES WITH THE REASONS THEREOF

In California 6 men were conjugerted (?) to 6 women in order to beget many and well conditioned children, and for the greatest venereall pleasure, in manner following, viz:

One man excelling in strength, nimblenes, beauty, wit, courage and good senses, had 4 ingenious healthy women assigned him; to bee kept apart from all other men, and under penaltyes.

One Great Rich Woman had 5 men at her command, and was absolute mistress of them all; and all these 5 men had also one woman in comon to them all, kept strictly up, so as to bee ready for any of the same 5 men upon all occasions.

(Memorandum. That the said Mistris usd which of the said 5 men shee pleasd; but none of the said 5 men medled with the comon woman without leave of the mistris, and unlesse she had no need.)

And the mistris pitched upon one of the 5 till shee was with child. And the comon woman prevayld with the 5 to have one man in particular for the same end. The 4 other [women] brought excellent children, and the other better than none (?), by 2 of 5.

The Reason of the said Marriage

1. The children of 6 women are gotten by one 2 or 3 choice males.

2. The Great Man's keeping 4 wives with their 2 women, is less than the present ordinary charge of one wife.

3. That tis more content to have the choice of 4, then to be tyd to one, and to wait when that one is indisposed.

4. The man useth her of the 4 that is most ready or best beloved.

5. The Great Woman using 5 men that follow their trades and bussineses, needes give them but 30£ per annum each, besides gratuities.

6. The 5 men, out of their said sallery and trades, maintayne their comon woman and her issue.

7. The said Great Woman hath full satiety of use of men for 150£ per annum, and her children.

8. Each of the 5 men may have the Mistris if she pleases, but if shee [do not], the comon woman, who is always at home for them—if 2 come together, at her election.

9. The 4 Great Man's wives have enough, as much as is allowd in other countryes [when they] may be in health, and are all rivalls for the husband's benevolence.

10. Of the children producd, the parent appoints which shall have 4 wives or 5 husbands.

11. The Hero[1] keepes the children of his 4 wives.

12. The Mistris[2] keepes her owne children, and gives 30£ apiece to her 5 husbands.

13. The 5 men keepe the comon [woman] and her issue.

14. Only the Hero and Mistris have other expenses.

15. The Hero and Mistris have their full and choice of venery. The 5 men [have] servants enough, with some choice.

16. The 4 wives and 5 servants are comon [and] are at no expense—Nor the Hero and Mistris, so much as is here and now upon all.

17. The encrease of children will be great and good.

18. No controversy about joynture, dower, maintenance, portion &c.

The Rich Woman keepes 5 men and two women, 3 servants for them, and 3 children; viz: 14 for 560£.

The Great Man keepes himself, 4 women and 4 servants (in all 9) at 450£ per annum.

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[1] *I.e.*, the "Great Man."

[2] *I.e.*, the "Great Rich Woman."

All women after 45 yeares old are free for their marriages, nor are they punishable for any *concubitus* after that age, but may make new contracts, but not with men under their owne ages.

Let the Mistris find a skirt, gowne, cap and tab, for her severall Coitors.

A (the Master) hath—n, o, p, q wive-servants; all to cost 140£ per annum.

Coitors B, C, D, E, F have—M for their mistris and W for comon.

The 12 spend 320£ per annum.

M, n, o, p, q, W all between 16 and 46.

A, B, C, D, E, F all above 20 and under 60 yeares old.

M to expend 40 + 125 + 15 = 180£ per annum.

B, C, D E, F to spend 25 on W 25.[1]

No. 94

About the Encrease of Mankind

(1) That no woman bee punished for bearing a child, but left to God and her owne conscience and honor.

(2) That any woman with child be receivd and entertaynd 28 dayes for her delivery, giving security to pay 12*d*. per diem for more.

(3) That in such case she leave her child, or give security it shall be well kept and educated in usefull bussiness till it bee 15 yeares old.

(4) That a woman of 18 yeares old do pay 10 shillings if shee has had no child, and 10 sh. more every yeare, if she has had no child since her last

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[1] A, B, C, D, E, F evidently here represent the six men, and M, n, o, p, q, W the six women, of Petty's ideal household on the 'Californian' principle, A being the 'Great Man' or 'Hero,' M 'the great Rich Woman' and W the 'common woman.' I am, however, unable to explain the calculations as to their interior economy, but Petty was clearly convinced that the system would prove both cheap and prolific!

payment. The same to continue till shee [be] 44 yeares old. The said payments to bee applyd to the nurseryes &c.

(5) Women of high quality to pay more in proportion,—to bee considered of.

(6) That men and women may cohabit upon any covenant they please, which the magistrate shall see well performed.

(7) That [there be] hospitalls for childbed women, and others for children to one yeare old, others of between 1 and 3, others of between 3 and 7, others of between 7 and 10.

(8) That quitted children bee servants to the publicq for 25 yeares.

(9) That the publiq may sell these children, and that those who buy them adopt them.

(10) That the marriages already made bee sacredly observd.

(11) That children bee bred up with the breast.

No. 95

On Doubling the People 1687

The State of the Case

	millions
There are in Great Brittan & Ireland, and in the Isles of Jersey, Guernsey and Man, 9 millions seven hundred thousand people, worth at 70£ per head	679
There are of acres in the said Land 72 millions: whereof those in England, worth 11 millions per annum, at 20 yeares purchase are worth	220
And the housing, furniture, provision, merchandize, cattle, shiping, money, Plate and Jewells are worth by good estimate	150
The Land of Ireland worth 1200^{m}£ per annum, and at ten yeares purchase anno 1687	12

	millions
The Housing and personell estate of Ireland	8
The Land of Scotland, worth 900^{m}£ per annum, and at 20 yeares purchase	18
The Housing and personall estate of Scotland	8
	£1095

If the people of the 3 nations be doubled:—

The people of the said 3 nations will be worth	1358
The lands of England will be quadrupled	880
The personall estate of the same will be doubled	300
The lands of Ireland (now undervalued) will be sextupled	72
The personall estate of Ireland doubled	16
The lands of Scotland will be quadrupled	72
The personall estate of the same doubled	16
	£2714

Points to be proved:

1. That the people may be doubled in 25 yeares.
2. That doubling the people will quadruple the value of the lands.
3. That 3 acres 3 quarters (well cultivated) will maintain one head, at a medium of men, women, and children.
4. That the moderate labour of 13 millions (not exceeding 12 hours per diem upon necessary business) will soe cultivate 72 millions of acres, as to be sufficient maintenance for 19 millions 400^{m} of people.
5. That a child of a yeare old (if bred up to necessary business) is worth 4£, and the same at 20 yeares old 140£; the medium or halfe whereof is 70£.

The Advantages of Doubling the People:—

1. There will be a gaine to the 3 nations of 1619 millions[1] in 25 yeares.

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[1] *I.e.*, the difference between the two totals given above.

2. The foreign Trade of these nations will be Tripled.
3. The charge of the government will come done to a hundreth part of the expence of the people.
4. Interest of money must fall to 3 per cent.
5. At 25 yeares end, above 600^{m} heads, in 3 thousand extraordinary shipps, may be yearly sent to the American Colonyes.
6. The King will be the greatest in Christendom without warr or bloodshed.

No. 96

Cogitata de Connubiis

Ad gignendum et alendum prolem; Ad fruendo amores et colendum ♀; Ad augendum rem.

Foeminae omnes a 16 ad 40 annos habeant viros.

Cesset matrimonium Anno oetatis 40^{mo} uxoris et dividantur opes ac nuti sunt in morte mariti.

Habetur illa sterilis quae duobus maritis p . . . ve habentis non pariet, nec alios plures habeat.

Foeminae steriles, et 40^{m} annum superantes, liberae sunt ad quamlibet Venerem cum viris innuptis et absolutis.

Viri (post nuptas omnes foeminas 40^{m} annum nondum agentes) liberi sunt ad quamlibet venerem cum sterilibus et supra-annuatis.

Viri et foeminae a matrimonio soluti possunt alios contractus de cohabitando restaurare, vel inter se vel cum aliis; De prole ♀ et re.

Qy. An contractus matrimoniales solvendi ante 40^{mo} anno uxoris sunt tolerandi?

Qy. An magnalibus concedi possit plures conubiae et adjutores Thori; et ex qualis causis et mulctis?

Qy. Quid Statuendum est de Incesta, sive de coitu cum matre, sorore, et filia?

Non solum coitus sed concubitus nudernus sive

clandestina et pudendorum tractatio, peccantium nuptorum morte puniatur.

Contractus et solutiones connubiales magistratibus vindisentur (?) et registrentur.

Coeuntes (foemina aliqualibus nondum inuptis) luent poenas, cogendi ad personam uxore dum exhibitu magistratus.

Liberi 40° anno matris assignentur dotes, reservando ad parentes ut concordatum fuerit ante matrimonium, vel post consensu magistratus.

> Qy. An vir poterit secondas nuptias habere post primas solutas ex supra-annuatae uxoris, data libertate coeundi in qualibet sterili vel supra annuata ?

XIV

MILITARY

(97) An Essay to make Military Questions demonstrable; Fortifying the City of Dublin—(98) An Appendix Concerning London—(99) War Chariots—(100) Of War Chariots.

MILITARY

PETTY'S unpublished papers on naval matters are of such volume as to preclude any idea of their incorporation in this publication. His contributions to the Art Military are, however, of sufficiently modest dimensions to permit of their reproduction.

An *Essay to make Military Questions demonstrable* (No. 97) seems, from its title, to have been the beginning of one of his more ambitious papers, but so far as it goes it deals only with the Fortification of Dublin, while the *Appendix Concerning London* (No. 98) is added in the nature of an afterthought. The subject is treated in the method of ' Political Arithmetic.' In the " State of the Case," the data (so far as they were ascertainable) concerning the area and property to be defended, and the method of defending them, are first given; and this is followed by " Questions resolvable out of the premises "—*i.e.*, the nature and ' profile ' of the fortification, with the necessary equipment for its defence.

The *Appendix Concerning London* may be compared with the papers on a *London Wall* printed *supra* (Nos. 10 and 11). These, however, seem to have been written with a different object, for the Wall they contemplate was to be made for administrative rather than for military purposes.

From 1676 onwards Petty was constantly experimenting on a new form of ' calash ' or posting chariot (*infra*, Section XXI). It may have been his enthusiasm in the pursuit of the ideal travelling conveyance which led him on to the subject of *War Chariots* (Nos. 99 and 100). In reading these papers one cannot fail to be struck by the similarity, *mutatis mutandis*, between Petty's conception of the War Chariot and the 'Tank' of the Great War. The War Chariot, like the tank, was to ' run & push with great violence against any object,' and, when it had penetrated into the enemy's position, was intended to remain there—a ' Fort Royall,' immune from destruction. Like the tank, again, it was to be self-contained, to carry its own armament, and its own protection from enemy fire—while it was intended to act alone, in formation, or in combination with other arms, as circumstances might require.

After careful calculations of their initial cost in construction and equipment, of their daily cost of maintenance, and of their striking power, Petty arrives at the conclusion that his war chariots with their crews would be of greater military service, though of considerably less expense, than an equal number of men operating as infantry or cavalry. All these claims were to be made good, though under conditions which Petty could scarcely have envisaged, in the modern 'war chariot' with which we have now grown familiar.

No. 97

An Essay to make Military Questions Demonstrable (1680)

The first instance is the fortifying of the Citty of Dublin.

The state of the case

1. The land within the liberties of the Citty of Dublin, containeth —— English Statute acres, whereof —— acres are covered with buildings.

2. The said buildings do consist of 5000 houses in which do inhabitt 40,000 Soules, men women & Children.[1]

3. Of the said 40,000 Soules, one quarter are Males of above 16 years old, the one halfe whereof are able and fitting to bear defensive Arms in Case of Necessity. That is to say, there are 5000 such men now living within the liberties of the Citty of Dublin, whereof 3000 have been lately seen in an hower in one place together, in troops and companies compleatly Armed, and under the other necessary curcumstances of Marshall Discipline.

4. It is believed that within the said Citty are 20,000 Armes in publick and private hands.

5. The vallue of the said 5000 houses at 200£ each

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[1] In the Dublin *Observations* these figures are increased to 6,025 houses and 58,000 inhabitants.

is one million of pounds sterling, and it is hoped that the money, plate, Jewels, furniture Ware, and provisions &c. with the land and live cattle within the said Liberties, is worth one Million more; in all 2 millions.

6. The fewell spent in Dublin is about 30000 tunn of pitt coles brought out of England, the Excise of the said Citty is —— per annum, and consequently —— Tunne of beere and Ale is probably spent in that Citty yearly, which is made out of about —— barrells or —— bushells of barly.

7. There comes into Dublin yearly —— Tunne of Shiping, reckoning each Ship for soe many times its burthen as it maketh voyages.

8. The Chimnies of the houses whereof Papists are the Masters are ——, and whereof Protestants are Masters are ——, and the number of papists that live in protestant families are ——, and the number of protestants that live in papists families are ——.

9. The wages of a labourer at Dublin is, —— of a horse and carriage per diem ——; of an Artisan ——; a cubicall foot of stone work is worth a penny, the digging of a cubicall yard of ditch is worth 2 pence.

10. The number of Impotents and beggars about Dublin are ——; the number of able bodyd men which have no Employment are ——.

11. The number of Arms out of Dublin in Ireland are under 30,000, and the greatest number of men that ever was in Arms in Ireland at any one time, even between the yeares 41 and 53 (comprehending the Royalists and Parliamentarian Protestants, as also the Royalist and Papist Clergy putt all together), never Exceeded 30,000 defective men at any one time; neyther were there in England and Scotland and Ireland above 200,000 men in Arms at any one time; vizt, not above one fortyeth part of the whole people.

12. The present Castle of Dublin Stands upon —— acres of Ground, and the Old Citty of Dublin consists

of —— acres of ground; and consequently there is —— acres of built ground, or —— families, without the old wall of the said Citty, which are in the nature of an Open Village.

13. There are within 12 mile of Dublin, or within a small winter dayes Journey of the same, —— protestant familyes.

14. There are within the liberties of Dublin —— horses fitt for Service, and —— horses of the same kind in the whole Kingdome.

15. The sea line which incompasseth Ireland (reckoning to the first fordable part of every River) contains —— English Statute miles; in which line there are —— places, where men may land at all times of the tide, & —— places where men may land 12 howers in the 24.

16. Twopence for every Coach and a halfe penny for every horse, and one farthing for every head that passeth in and out of the said worke per annum, would amount unto a Revenue of —— per annum.

17. The vallue of the houses and land within the said fortification would be advanced at least fower per centum or 40,000£,[1] which is estimated to bee the charge of this undertakeing.

18. There is allwayes in Dublin 500 Tunne of Iron, 5000 load of Timber, 100,000 Deale boards,——Smiths and Armourers and Joyners and Carpenters.

19. The Charge of 5000 long Guns, 5000 Muskets, 3000 blunderbushes, 1000 Carbines, 1000 pairs of pistolls, 200 peeces of Ordnance weighing 200 Tunne, 2000 barrells of powder, 40,000 hand Granadoes, will all come within the charge of 50,000£.

20. Two hundred thousand pounds will feed 30,000 Mouths for six months, and 20,000£ in ready money would bee necessary.

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[1] In the *Political Anatomy* the cost of Fortifying the City of Dublin is estimated at £30,000 (Hull, 147).

Questions resolveable out of the Premisses, vizt:

1. *Q.* What is the length of the greatest line, that 5000 men can defend?

I answer: The length of the bodyes of the said 5000 men, which by neer Estimate is 30,000 foot, making above 5 English miles and a halfe.

2. *Q.* At what distance from the said line is to be voyd of and clear of houseing or any other shelter?

A. The space that a good Musket can carry point blanck, or the distince at which a good Marksman can hitt a man, which distance is between 6 and 800 foot.

3. *Q.* What voyd space ought to be left from the wall inwards upon which to make new fortifications, if need bee?

A. About 100 foot.

4. *Q.* Of what heigth ought a wall to bee in this case?

A. Fifteen foot, and $\frac{1}{5}$th of the same in thicknesse, and lined with an Earth work ten feet high, and 8 foot broad at the Top and battering at 10 foot at the bottome; with a ditch out of which the said Earth was taken, fenced on the other side with a crest worke of 5 foot high and 5 foot thick, or rather 5 foot and a halfe at the bottome and 4 foot and a halfe at the topp.

5. *Q.* Whether 5000 marksmen, haveing 150,000 Muskets, long Guns and blunderbushes, and ten thousand women and boyes to help them, may not bee equivalent to 20,000 Ordinary Musketeeres?

A. They may very well.

6. *Q.* How many men may the said 5000 defenders resist and destroy from the wall aforesaid.

A. Thirty thousand, for there being a shelterles space of 6 or 800 foot from the wall outwards, the defender can fire, with the help of his women and boyes, 6 times whilst the Enemy can march over the said 6 or 800 foot of Shelterlesse ground. Moreover the defender can fire perhapps three or 4 times more before the Enemy (Even by help of a Ladder) can get over the wall, in case he can live to bring it; and in case he got up to the topp of the wall upon the outward parapet, the Enemy is still open to those who fire from the brest work of the Ditch, and is lyable to the Granadoes which shall bee throwed in upon him whilst hee is passing the ditch. So that it is not hard to conceive that one good Marksman, fitted with his 8 Muskets, armed with the 3 sorts of Gun aforesaid, fitted with breakes to prevent requilding,[1] with his assistant women and boyes, may deliberately make 12 shots whilst the Enemy is comeing from 600 foot without the wall, and whilst hee goes over the wall and thorow the ditch, and over the small inward parapet, especially when the said wall shall bee of the most advantageous figure.

7. *Q.* What will the Charge of the said wall and ditch bee?

A. Six and Eightpence per foot running, or tenne thousand pound in the whole.

8. *Q.* How many bastions or bulwarks will the said line require?

A. Fforty with 5 peeces of Ordnance upon each, worth 20£ each.

9. *Q.* How many Gates should there bee in the said line?

A. Six, and two bridges over the River at each End, the charge whereof to bee 1000£.

10. *Q.* How many acres of ground will this work stand upon, being 30,000 feet long and 30 foot broad?

A. About 60 acres wirth about 1000£.

11. *Q.* In the time of the Seige how many sorts of men ought to be putt without the worke?

A. Impotent, and incureable persons ought to be sent to some place where provision is cheap, as also the small children of very poor people. (2ly.) Persons of whose affections there is reasonable doubt, who do not labour with their hands, but live by some Craft or retayling Trade, or have noe such substance within the Towne as will ingage them to defend it, or such who cannot secure as hostages some eminent persons without the towne, to be ejected.

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[1] ? recoiling.

12. *Q.* What further fortification may there bee added?

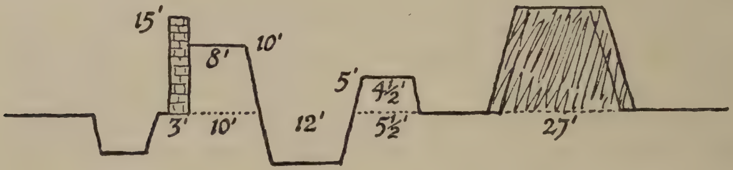
A. Two sorts, vizt: eyther an Earthwerk made upon the 800 foot of reserved ground, consisting of a broad and Deep ditch, and an earthwork within it made of what is digged out of the ditch; or else of an earthwork to be made without the 15 foot wall, of what bignes, and of as large a ditch as shall bee thought necessary for the occasion.

13. *Q.* What is first to bee done?

A. To make the said 15 foot wall without any earthworke at all, eyther within or without, together with six Gates and two bridges.

14. *Q.* Of what use will such a wall bee?

A. 1. It is for defence againste horse and foot under the number of 10 thousand. 2. By this wall and Guards at such Gate, the Governor of the Citty can easily know what persons, Strangers and others, are at any time within the walls. 3. In case of fire, Murder, Robbery &c. they can, by shutting the Gates, prevent many inconveniencyes ariseing from the same, and probably find out the Mallifactors. 4. This wall may bee soe emprovd as that noe prisons shall bee necessary within the Citty. 5. Within this wall may bee received the Goods and Cattle of well affected persons flying to Dublin upon a sudden Insurrection. 6. Tolls, Customes, dutyes, &c. may be more exactly collected. 7. It will bee thought fitt, upon makeing such a wall, to make a new division—wards, parishes and other presincts more suitable to the present state of the inhabitants. 8. If any persons are to bee excluded or admitted, the rules concerning the same will bee more intelligible and practicable. 9. It is an Antient and Universall practice to incompasse a Citty with a wall, and all inclosed land and houses are of the greater vallue for being walled in; And the vast Citty of London was incompassed with a line of Comunication of near 12 mile about, to the great advantage of these who did it. 10. If any great Consultation or other great preparation is to be had, then 40 men keeping the Gates of this wall, they may force the 40,000 living within it to silence for any reasonable time. 11. If this wall were made, it is probable that an exact Account of all the people living within it would be taken, and constantly kept &c. 12. The makeing of such a wall would bee a terror to disaffective persons, and a great incouragement to plantation when men shall plainly see that noe Rebellion or insurrection whatsoever can last long, but shall certainly end in the ruine of those who raised it.



[The remaining part of this paper must have been written at another time, for it seems to contemplate quite a different and a much larger wall than that which is proposed above. Petty had either forgotten what he had previously proposed, or else the ensuing notes belong to another essay on the same subject, but on other lines.]

We have determined the length of the Circumvalation, by the number of the defendants. Wee next determine the hight of the wall (from the bottome of the graft to the Top of the parapet) to be the hight or length of so many men as wee intend that one man within this work should resist. That is to say six in this present case, wee intending that 5000 within this work shall keep out 30,000. So as this wall is to bee 36 foot high, vizt: 16 from the bottom to the top of the graft, and 15 from the top of the graft to the foot of the parapet, & 5 more to the top thereof.

Lastly wee determine the thicknes of the wall, from within the parapet to the outward edge, to bee the length of three men. Which will make roome for 6 standing upright one behind the other, so as if the whole 30,000 beseigers shall attacque onely one sixth part of the Towne, there will bee roome enough upon one sixth part of the wall, to draw up the whole number of defendants against them. 2ndly. The thicknes of the wall may bee tribble to what the defendants best Ordnance will penetrate.

If it be asked how much gunpowder is necessary for this towne, I say that the least quantity is 30,000 musket shots, which at 15 shots to the pound makes 2000 pound weight or 20 barrells, the decuple whereof (or 200 barrells) is worth six hundred pound.

I conceive a hand Granade not to be worth above 4*d.*; at which rate 15000 such Granadoes will come but to 250£.

Every shot out of a great gun (one with another) may bee reckoned at 4 pound, or according to the allowance of ships, a barrell to every Gun. Which for the 200 gunns is 200 barrells; which makes 5000 shot, whereas 20 barrells makes 30,000 musket shot. Wherefore, unlesse a great gun can kill 3 score enemies with the same certainty that a musket can kill one, it is manifest that small shot is the safer and cheaper way of execution.

The question shall bee, what provision ought to bee made for pioneers? Answer: 100 wheelebarrowes, 200 pickaxes, 300 spades and 400 shovells, in all 1000.

The number of horse ought to be 1000, & 900 dragoones.

This Garison ought to be furnished with 12000 weight of course wooll for the sudden stopping of any breaches, and for rendring fruitlesse any batteries that the Enemy shall make.[1]

We said that the line might be equall to the length of the defendants, which in the case of Dublin, will take in twice as much ground as the houseing of the said Citty do stand upon. So as the question will bee, for what reasons the line ought not to bee lessend, and brought nearer to the houseing? For which I offer the reasons following, vizt: 1. The Citty of Dublin doth dayly increase in houseing. 2. A large line renders the Enemies granadoes lesse usefull. 3. A large line will enable the towne to receive its friends from the Country with their Cattle and goods. 4. The pastureage next without this line, and within musket shot, will contain 1500 acres of land, and will feed 2000 milch cowes all the Sumer. 5. Within these large works will bee good roome for retrenchments in case of breaches. 6. There will bee graseing for 500 horse within the works.

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[1] *Cf.* 'of Wool Walls,' *infra*, No. 103.

(*Endorsed.* "Fortifications of Dublin: 1680.")

No. 98

An Apendix Concerning London

1. Whereas the line of circumvalation about Dublin was 30,000 feet in length, or 5 mile 3 quarters; I further say that double the said line, vizt: 11 mile and a halfe, will take in all London, Southwark & Westminster, with all the Hamlets thereof, from Blackwall to near Chelsy on the Northside, and from the Eastermost part of Redriff to ffaxhall[1] on the Southside.

2. London understood as aforesaid, contains 12 times as many people as Dublin, and the value of the houseing in London and the goods in these houses is about 3 score times as great as that of Dublin; so as London is six times better able to man their line then Dublin, and 30 times better able to bear the Charge of

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[1] Rotherhithe, Vauxhall.

makeing it. From whence it followes, that London may afford to make their line more dureable and beautifull, then that of Dublin. I might also say more strong, but do conceive there will bee no necessity thereof, for—if all the forces of all parties which ever were in Arms together in England, exceeded not six score thousand men, and if noe one Army ever consist of 40,000 men, and if 20,000 defenders within the said line are equivalent to six score thousand without it, and lastly if there will be not onely 20 but neer 90,000 fighting men, within the said line—it followes the same need bee noe stronger then what was propounded for Dublin. For a thing may be overdone as well as underdone, and the slighter the line is, the more easyly it may bee altered as Emergency accidents shall require it.

Among the many Excellent uses of this line, one which seemes to bee of present use is, the easy seclusion and seperation of the ill from the well affected party, which now live too premiscuously together. For if the melignants were bound under a penalty to wear a mark of distinction, I say that such a mark and this line would facilitate that work which hath hitherto been perplexed and troublesome.

No. 99

War Chariots

Considering the frequent mention of chariotts in the Battles of the Ancients, it seemd that chariots might also be of use in the present way of fire armes; and first:

1. That a Chariot armed with a small field piece of 100 lb weight, with 9 Muskets, 9 Blunderbushes, 30 Hand Grenades, 2 Pykes, 6 swords, powder and shot, a Tent for 12 men, an Hatchet and Kettle, might be made of 600 lb weight and 20£ expence.

The chariot to go upon 2 wheeles of 6 foot diameter, and armed with Pykes in the front thereof.

2. It seemed that 12 men within the said chariott are able to encounter 12 ordinary horsemen or troopers, or 24 Foot soldiers, half pykes halfe musketiers.

3. That 1000 of the said chariotts (with 12000 men), are able to encounter 4000 horses, 4000 horsemen, 8000 Musketiers and 8000 pykes, and to encamp themselves every night in any place with Tents for their men, and to march neere 20 miles per diem.

4. The said 12000 men are able to fire 1000 field pieces, all at a clap, and within ½ a minute 3000 Musketts, the like the next ½ minute, at the next ½ minute 12000 Blunderbusses and the next 12000 granadoes.

5. And with the fixt and loose Pykes to put off horse or foot; and also with club, musketts, and swords to do execution within or without the chariott.

6. The chariott is able to carry 3 dayes victualls for 12 men, with hatchet and kettle to drese the same.

7. To run a push with great violence against any object, with the strength of 12 men upon 2 wheeles.

8. These 1000 chariotts are to bee divided upon service into severall squadrons, and each squadron into severall figures and orders, so as to answer any intention of service, deffensive or offensive.

9. Loose artillary, loose horse, foot and pioniers, are to bee adapted to the said chariotts.

10. When any of the said chariotts are broaken and disabled, the same may bee with drawn without prejudice to the rest, and a new figure found in a moment.

11. So as 12000 men at 20^{m} pound seemes to be a provision against a Common army of 16000 foot and 4000 horse and Artillary.

12. And are able to march in all wayes and weathers, with good armer, Tents, and all other necessaryes, and to carry a pyke, one sick or wounded man, or 2 in case of necessity.

N.B. That the aforementiond army of horse[1] will cost 80^{m}£, and the 16000 foot 16000£, and the artillery of 400 weight ——; and with amunition &c. so much as to make the whole 100^{m} pound, or quintuple to the new forme of chariotts.

No. 100

Of War-Chariots

1. The Weight of a War Chariot is 650 lbs, to bee drawn with one horse (of 6£ price) with the help of 9 men and a boy:

	lbs.
The chariot and wheels	200
6 muskets and 6 Blunderbushes	144
6 picks and 9 swords	90
A hatchet spades and kettle	14
A Tent Cloath	40
30 hand Grenados	30
A wicker hurdle	20
Carbines and Pistolls (or mere Blunderbushes)	72
	610
The weight of 2 days provisions for 20 men, and amunition with powder and shot	40
	650

2. The Cost of each Chariot compleatly fitted and furnished is 30£:

	£	s.	d.
2 wheeles and Body of the chariott ..	4	0	0
An horse and tackling	6	0	0
6 muskets and 6 Blunderbushes at 15*s*.	9	0	0
6 pykes and 9 swords at 5*s*. each ..	3	15	0
A hatchet, spade, and kettle	0	10	0

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[1] *I.e.*, the 4,000 horse, *supra*.

	£	*s.*	*d.*
A Tent cloth	1	10	0
30 granadoes	0	10	0
A wicker-hurdle &c.	0	5	0
	£25	10	0
Carbines and pistolls	2	10	0
Drum, Collours, and omissions per estimat	2	0	0
	£30	0	0

3. 18 such Chariots, man'd with 210 Men are equivalent in service to 4 Troopes of horse consisting of 208 Men.

4. 18 such Chariots are equivalent to 6 Foot Companyes consisting of 420 Men.

5. 18 such Chariots will cost 540£ and will spend 12£ 11*s.* 0*d.* per diem.

	£	*s.*	*d.*
For every chariot there is 9 men and a Boy, whose wages one with an other at 10*d.* per diem is	0	8	4
5 chariots more is	2	1	8
A Captain, Lieutenant, and Ensigne	1	0	0
A carpinter and Smith at 18*d.* per diem	0	3	0
Meal for one small horse	0	0	8
Expence of amunition for the 6 chariots per diem, one with another	0	6	0
	£3	19	8
Two sergeants and a drum	0	4	0
(For 6 chariots)	4	3	8
18 chariots man'd with 210 men, costing per diem	£12	11	0

6. The 4 Troopes of horse abovementiond will cost raising 4240£, and will spend 28£ 4*s.* 0*d.* per diem.

	£	s.	d.
The charge for a troop of horse, consisting of Captain, Lieutenant, and Cornet, and quartermaster at 10*s*. per diem ..	2	0	0
2 Trumpetts, drum and two Corporalls	0	15	0
43 Troopers at 2*s*. per day	4	6	0
	£7	1	0
Four of the said troops containing 208 men do come to per diem	£28	4	0

7. The said 6 Foot Companyes will cost the Raising 328£ 18*s*. 0*d*., and will spend 22£ 9*s*. 6*d*. per diem.

8. An Army of 1000 Chariots will make a Wall a Mile and halfe long set in front, and of 3 Miles long set end wayes.

9. This Army of 1000 Chariots will Cost 30$^{\text{m}}$£.

10. They must bee mand with 11655[1] Men, the charge whereof will bee 700£ per diem, and 255$^{\text{m}}$£ per annum.

11. 80 Troops of horse, consisting of 4160 Men, will cost 84800£ the Raising; and their pay per diem will bee 565£, and are equivalent to 360 Chariots.

12. 640 Chariots are equivalent to 227 Foot Companyes, Consisting of 15890 Men; the raising whereof will Cost 11679£ and their pay will bee 795£ per diem.

13. The pay of 80 Troopes and 227 Companyes[2] will bee 1360£ per diem, whereas that of the Chariots is but 700£; and the Charge of raising the said horse and foot will bee 96479£ (or 100$^{\text{m}}$£), whereas that of the Chariots was but 30$^{\text{m}}$£, and 11679 Men are equall to 20050.

14. The Chariots Cost 30,000£ (700£ pay per diem, 11694 men).

The other Army 96479£ (1360£[3] per diem, 20050 [men]).

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[1] It will be observed that this figure (the total of the crews of all the chariots) varies between 12,000 *supra* and 11,679 *infra*.

[2] Together the equivalent of 1,000 chariots, *ut supra*.

[3] *I.e.*, the combined pay of 80 troops of horse and 227 foot companies, *ut supra*, § 10.

15. The difference between the Charge of raising the said Armyes is 66479£ and of Maintyning the same for one yeare is 245^{m}£.

Their Effects

This Army, 1000 Chariots mand with 11679 Men and 1000 small horses, whose pay is 255^{m}£ per annum and whose charge raising is 30^{m}£, can performe as followeth, vizt:

1. March 20 Miles per diem.
2. Cary 2 dayes provisions with kettle, spades, pickaxes, hatchets.
3. Cary sufficient Tents and Covering for the Men.
4. Encamp safely in an howers time.
5. Make a line of a Circumvallation about any Town they would besiege in two howers time.
6. Make a Bridge to passe any River under 5 foot deep.
7. Make a Fort Royall in any open place.
8. Make vast baricadoes else where.
9. Provide for sick and wounded Men.
10. Cannot bee hurt by swords and pykes.
11. Are furnished with field peeces, Musketiers, Blunderbushes, Granados, pyke and swords.
12. Can defend the sea Costs against 100^{m} Invaders.

XV

WOOL WARFARE

(101) Of Coarse Irish Wool—(102) The uses of Wool in War—(103) Of Wool Walls—(104) Of an Artificial Harbour or mold for ships.

WOOL WARFARE

DURING the Commonwealth the Dutch had made such advances in the manufacture of woollen goods, that the English cloth trade appeared to be in jeopardy. After the accession of Charles II, and for the purpose of checkmating the foreigner, two statutes were passed (1660 and 1662) forbidding the exportation of the raw material from England to the Continent (*Treatise of Taxes*, Hull, 594), with the result that there was soon a glut of wool at home.

The suggestions contained in the papers which follow (Nos. 101, 102, 103), though somewhat fantastic, were evidently written with the object of absorbing some of this surplus product. They can be roughly dated by reference to other portions of the Petty MSS. Thus, on 22nd December 1678 Petty writes to Southwell that he is "drawing up a scheme for a new wooden or woolen wall against all the enemies of England," while in January and February 1679-80 we find among the MSS. a note of experiments conducted with Mr. Hooke and Mr. Hunt, in order to ascertain how far bags filled with coarse wool were penetrable by a pistol bullet. In the plan for the Fortification of the City of Dublin (*supra*, p. 69) the use of 'wool blocks' is recommended 'for the sudden stopping of any breeches & for rendering fruitless any batteries that the enemy should make.'

In No. 104, which is dated 1686, wool is relegated to a subordinate place in the construction of Petty's *artificial harbour or mold for ships*. In the suggestions for a wall round London (*supra*, No. 11), written in 1687, it is not mentioned at all. We may therefore conclude that its inventor was ultimately forced to the conclusion that "Wool Warfare" was scarcely a practicable proposition!

No. 101

Of Coarse Irish Wooll

1. There is exported out of Ireland every yeare 6000^{m} (cwt. ?) weight of wooll.[1]

2. The worst half thereof is not worth 3£ per ℔, so as the said halfe is worth but 37500£.

3. The said quantity of wooll will make a Million of cubicall feet, or a cube of 100 feet in the side.

4. 8000 small horses will carry and march with all the said wooll 20 miles a day.

5. A ship will carry $\frac{1}{3}$ of its full burthen, but such shipping may bee built as will carry $\frac{2}{3}$.

6. The same wooll will make a wall of 5 feet thick and 6 feet high, of about 6 miles long, or the equivalent in any other dimensions.

7. The said wall may be formed into cloth cables and castles, of severall convenient dimensions and shapes, as occasion shall require.

8. Men of strength (tho of no skill or fidelity) may be employed and trusted to carry this wooll, and place it as 2 or 3 skilful men shall direct from time to time.

9. Abundance of wooll is peculiar onely to the king's dominions.

10. The 8000 horses will be of other uses, and as dragoons besides.

11. Hemp, Hay, straw, Fagots, Earth, cannot answer the ends of [what a] wall of wooll can doe.

12. All works of wooll are easily undone and carryd away in a moment, so as no enemy can take advantage of them when quitted.

Advice

1. That 40^{m} worth of coarse wooll may be in readiness at 10 places in Ireland.

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[1] The figures in the first two paragraphs are impossible to understand. In the *Political Anatomy* (Hull, 175) Petty gives the export

2. That ten ingenious soldiers may bee ordered to consider and study this new way of wooll warfare.

3. That a convenient number of mechanics may be orderd to exercise the practice of the same.

[Sir Christopher Wren, Mr. Hooke, Sir Anthony Deane, Mr. Sheeres, Mr. Henshaw, W.P., 3 seaman, 3 Land Soldiers, Sir Jon Windham, Sir Jon Wisden, Coll. Legge, Lord Dumbarton, Sir Jon Narberon, Mr. Pepys.][1]

(*Endorsed.* "Wool Warfare.")

No. 102

The Uses of the said Wooll in War

1. To passe any river or bog, or rocky way, even with ordnance, with its anchors and castles.

2. To approach any fortifications quick and safely, and overtop any towne or workes.

3. To guard any harbour's mouth better than by any forts on shoare.

4. To block up any enemyes ships in rivers or close harbours, and make a digue.

5. To encamp any army in a strong towne with tents and blinds.

6. To hinder the landing of an enemy on whatsoever shoare, and stop the march of an enemy.

7. To build a strong towne anywhere in 2 or 3 howers time and remove the same as soone.

8. To protect a besegd towne from Bomboes.

9. To take away almost all the Impediments of winter as to Military Enterprizes.

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of wool from Ireland per annum as 2,000,000 lbs. In the *Political Observations* (p. 520 *infra*) as 5,000,000 lbs., worth £130,000, or about 6*d*. per lb. It seems that 3 *pence* per lb. must be here intended as the price, but this figure would not fit the calculations given.

[1] These were evidently the names which Petty suggested for a committee of enquiry into 'Wool Warfare.'

10. To elude the efficacy of great ships.

11. To fortify an open bared haven and such as Tangier, Dover &c.

12. To force [? reinforce] the Molds and Boomes of Argier [? Tangier].

No. 103

Of Wooll Walls

1. Of Wooll bricks of 1½ ℔. weight.

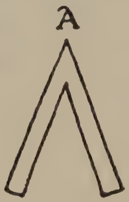
2. Of wooll cylinders of 10 ft. long, of 2 feet diameter to weigh ——

3. Of compounded cylinders to bee of 10 feet diameter.

4. Of wooll quilts weighing ¾ ℔.

5. Of wooll bricks fastened to casks, to make a mold for shipping, and anchoring the same.

6. Of a wooll angle (to be anchored by A) for ships to ride behind in open roades.



7. Of joyning the war chariots to the use of woolls.

8. Of Moats, batteries, bridges, approaches, bastions and brest works, to bee made extempore of wooll; and in castrations.

(*Endorsed.* "Of wooll forts viz: approaches, bastions, forts, bridges, beds, molds, harbors.")

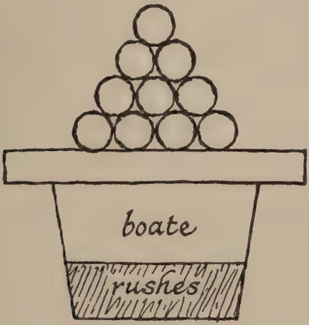
No. 104

OF AN ARTIFICIALL HARBOR OR MOLD FOR SHIPS

Proposal

Where there is a sinus on the shoare, to make a secure harbor for great Ships, (contayning about 20 acres of space, for the charge of about 20^{m}£) With a good defence for the same.

1. Make frames upon boates which may carry 10 sheafes of reed of 4 foot diameter, pild in pyramide, with another sheafe under the bottom of the same Boate. These Sheafes may bee of brush wood, Rushes, Coarse wooll &c.

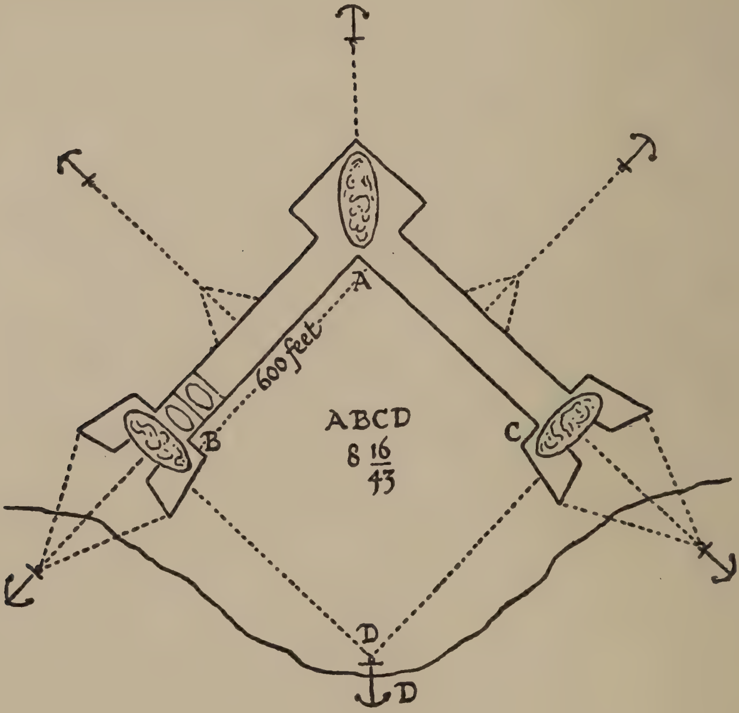


2. These boates & garniture must bee joynd by hookes & eyes, to bend with the heaving of the sea.

3. They must bee moared with Cables & Anchors. The Cable to bee fastned at the inside of the workes.

All this may bee removed from place to place.

(*Endorsed.* "Of an harbor or mold for ships 1686.")



XVI

DUBLIN PHILOSOPHICAL SOCIETY

(105) Rules for the Dublin Society—(106) Advertisements to the Dublin Society.

DUBLIN PHILOSOPHICAL SOCIETY

PETTY, as we have seen, was one of the little band of experimental Philosophers who used to meet at Oxford during the earlier years of the Commonwealth, and who came together again in London after the Restoration of Charles II. Gresham College was then, and continued for some time to be, their rendezvous, and in 1663 they were formally incorporated as ' the Royal Society for the Improving of Natural Knowledge by Experiments.'

The Dublin Philosophical Society of 1684 was founded, we are told, ' agreably to the design of the Royal Society of London,' and during its brief existence was always in close touch with the parent body. Its first meetings took place at a coffee-house on Cork Hill, but they were soon afterwards transferred to the " Crows Nest " in Crow Street. A museum, a laboratory, and a botanic garden were established for the use of its members, who appear to have been some thirty in number. Petty was its first president and William Molyneux, sometime Irish Surveyor-General, its secretary. It seems curious that their positions were not reversed, if (as Molyneux himself afterwards claimed) the sole credit for the foundation of the Dublin Society belonged to him.

Petty at any rate was mainly instrumental in drawing up both the original Rules of this Society and some ' Advertisements ' which set forth its aims and objects. Drafts of both these were among his papers and are printed below (Nos. 105 and 106).

He continued to watch over the Society's progress until his final departure from Ireland in June 1685. In March he reported it to be " pretty well thriven—They have already as much contribution as they need spend. Their number is above 30, whereof the greater part are very sufficient men " (*Corr.*, 17th March 1685).

The minutes of the Society (B.M. Add. MS., 4811) indicate that he was at this time the moving spirit in its debates. After he left Dublin it soon began to languish, and it finally broke up in 1687. A Philosophical Society was reorganized after the Revolution and met for a time in Trinity College, but it, too, disappeared. It was not till some years later that a third society, from which the present Royal Society of Dublin can trace direct descent, made its appearance.

No. 105

RULES FOR THE DUBLIN SOCIETY

The Society is to be called THE DUBLIN SOCIETY for the improuving of naturall knowledge, Mathematicks and Mechanicks, and Members thereof are to be named FELLOWES of the DUBLIN SOCIETY.

The person to preside over this Society is to be called Rector of the Society, who is to bee chosen by the Society. He is to continue in the place of a yeare and then a new election to bee. The Rector at the time of his election and taking upon him that office, shall have power to constitute a Deputy who in the absence of the Rector, during the whole year of his Rectorship shall bare his authority and office, Vizt: to preside at all meetings, to regulate the discourses thereat, soe that there be noe interruption, cavills, heat or confusion, but that everyone have fair liberty of proposing and speaking his mind, And this as briefly and pertinently as may bee. Hee is likewise to state and put questions, to call for reports, accounts and discourses, from those that promised them, and vigorously upon all occasions to promote experimentall Philosophy, Mathematick, Medicin, Mechanicks, &c.

The day for electing the Rector and other officers is to bee annually on the first day of November, being all Saints Day, unless it fall on a Sunday, and then the election to bee on the day following. The rules for electing officers and Members are to bee the same as of the Royall Society of London.

Likewise there is yearly to be chosen a person who is to bee both Secretary and Treasurer to the Society.

Hee is to keepe three bookes, Vizt: the booke of the Statutes of the Society, the admittances of Members and account of benefactors; secondly a Register wherein is to be noted all the Materiall passages of the meetings, All the orders constituted by them, All the experiments, discourses, letters, and other things as the Society shall think convenient; Thirdly an account booke, wherein the money paid and received shall bee noted, as also on what account soe received or paid. Alsoe the Secretary is to receive and answer all letters on the publique account of the Society, after that hee has produced such letter or answers before the Society and received the sence of them. And for the disbursement of money upon the sole warrant of the Rector, the Secretary and Treasurer may deliver out or dispose of any sums of money under twenty shillings; but for a greater sum he is to have a warrant signed by the Rector and the Major part of the Councill hereafter mentioned, or by the Rector and six of the Society. In the absence of the Rector and his Deputy, the Secretary shall preside.

Under the Secretary shall bee appointed a Clerke who shall have a sallary allowed him out of the Publick Stock, such as the Society shall agree to. His office shall bee to transcribe into the Register Bookes all discourses, experiments, orders, and other passages as the Society shall think fitt, as also to coppy out all letters received or sent forth.

And therefore it is ordained that every Member shall give in a coppy of whatever discourse, or experiment hee shall make before the Society, signed by his owne hand, that accordingly it may bee inserted in the Register booke.

And for the further regulating this Society it is ordained that there bee yearly Chosen besides the Rector and Secretary, a Councill of five, the Major part of which, with the Rector and Secretary, shall have power to present what they think convenient to alter or repeal in these or any other Statutes made for the Regulation of this Society, as also to present new ones to be constituted. All alterations or constitution of such Statutes shall bee performed in the Method of Ballotting by a full meeting, which for that purpose is to consist of at least five Members besides the proposers of such Statutes or alterations. And the said number of five Members, with the Rector and Secretary, shall be a sufficient and full meeting for the Aniversary elections and admittance of Members; and it is not required that the said five or any of them bee of the Councill. [This] only relates to the Presenting what is fitt to bee altered in the Statutes.

It is also ordered, that every Fellow at his admittance be obliged to pay nine shillings or two Cobbs,[1] and ever after during his continuance in the Society a weekly contribution of a quarter Cobb, for the defraying of all publique charges of experiments, letters &c., and other conveniences that are to be purchased; likewise everyone at his admittance is to subscribe the following obligation.

No. 106

Advertisements to the Dublin Society [2]

[3rd November 1684]

1. That they chiefly apply themselves to the makeing of experiments, and prefer the same, to the best Discourses, Letters and Books they can make or read, even concerning experiments.

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[1] A 'Cob' was a Spanish piece of Eight, which appears to have varied in value from 4*s*. 3*d*. to 4*s*. 9*d*. (*cf. Political Anatomy*, Hull, 186).

[2] These Rules are printed in Gilbert's *History of the City of Dublin*, vol. ii, 174-176. They are substantially the same as in Petty's draft, though the spelling has been amended and a 13th rule added to the effect that the President at such meeting is to determine the particular experiment for the next.

2. That they do not contemn and neglect comon, triviall, and cheap experiments & observations; not contenting themselves without such as may surprise and astonish the vulgar.

3. That they provide themselves with Rules of number, weight and measure; not onely how to measure the plus & minus of the quality and Schemes of matter, but do provide themselves with Scales and Tables, whereby to measure and compute such qualitys and Schemes in their exact proportions.

4. That they annalise and divide complicate matters into their intigrall parts, and compute the proportions which one parte bear unto another.

5. That they bee always ready with Instruments and other Aperatus, to make such observations, as do rarely offer themselves; and do depend upon takeing opportunitys.

6. That they provide themselves with Corrispondents in severall places, to make such observations as do depend upon the comparison of many experiments, & not upon single and solitary Remarques.

7. That they may bee ready to entertain strangers and Persons of Quality with great and surprising experiments of wonder and ostentation.

8. That they carefully compute their ability to defray the Charge of ordinary experiments 40 times per annum, out of their weekly contributions, and to procure the Assistance of Benefactors, for what shall bee extraordinary; and not pester the Society with uselesse or troublesome members for the sake of six pence a week.

9. That whoever makes experiments at the publiq Charge, do first ask leave for the same.

10. That the Secretary do neither write nor receive any Letters but shall bee communicated unto the Society.

11. That Persons (tho' not of the Society) may bee assisted by the Society, to make experiments at their Charge, upon leave granted them.

12. That for want of experiments there shall bee a review and rehersall of experiments formerly made.

(*Endorsed.* "Advertisments to the Dublin Society.")

XVII

AMERICAN PLANTATIONS

(107) Notes about New England—(108) Memorandum New England—(109) Questions concerning American Plantations—(110) The charge of 5000 acres in Pennsylvania—(111) American Planting—(112) General cautions concerning Pennsylvania—(113) Queries concerning the nature of the Natives of Pennsylvania—(114) A Proposal concerning American Plantations—(115) An Agreement between Penn and Petty about a Colony in Pennsylvania.

AMERICAN PLANTATIONS

THAT Petty was not incurious as to the conditions prevailing in the newly formed American plantations is shown by the frequent references to New England in his *Political Arithmetic*. The statistics relating to that colony which are printed below (No. 107) were, however, obtained by him after this work had been completed. There are two copies of this paper, the notes being written (as explained in the endorsement) in part by Petty and in part by a Doctor Taylor. I have been unable to establish the identity of the latter, but to judge from his spelling of the New England place names his knowledge of the American Colonies must have been of a somewhat rudimentary character. Mr. Frost and Mr. Bartholemew, who supplied the information, were presumably colonists or merchants on a visit to England. It is possible that the former was the soldier Charles Frost (1632-1677) who settled on the Pescataque River about the middle of the century, and after taking some part in the administration of the Colony, was eventually murdered by the Indians. Of Mr. Bartholemew, however, I can find no mention. Petty attached great importance to these papers, and in a letter to Southwell (*Corr.*, 10th September 1678) claims that they " contained more material truth than he had ever heard from others" about New England. The 'Memorandum' on the same subject (No. 108) was apparently compiled on later information.

Petty had made the acquaintance of William Penn before 1669, for it is recorded in Penn's unpublished diary that they dined together in Dublin during that year. Petty's papers and letters show that thereafter they were in frequent communication. Amongst the MSS. there is a copy of an exceedingly rare map of Pennsylvania made by John Thornton and John Sellar soon after Penn received his Charter in 1680, but before any part of the new Colony had been settled. Attached to the map are four pages of printed matter, giving a description of the Colony and the equipment required by intending settlers. This document is referred to in William Penn's first ' notices ' of his projected Colony, but only two other copies of it are known to be in existence (cf. *Of the first separate map* *of Pennsylvania*, by Worthington Chauncey Ford, Proceedings of the Massachusetts Historical Society, November 1923).

It seems that Lady Petty, with her relative Sir Henry Ingoldsby (but without her husband), had serious thoughts of embarking in the Pennsylvania venture at its first inception, but that their courage failed them at the last moment. The following letter, addressed to her by Penn, explains the incident:

William Penn to Lady Petty

Worminghurst 3rd 9bre 81.

Not knowing well how to direct my Letters to Sir H Ing[oldsby], from whom the note came that occasions this, I take the freedome of useing thy name in the superscription.

The contents of the note are to suspend for the present, your former resolution of haveing each a share in the province I am concerned in. Now, if you be remembred, I told you that I was come from Gravesend, & (when you mentiond being purchasers) that I wish[ed] it were not too late. However, if the ship was not gone,[1] I would incert your names, if you were sober & in earnest in the point—you saying as after dinner you resolved on it. I tould you I would putt you down in the addition to the Catalogue which I was to send to the Downs after the vessel, with 20,000 acres (makeing 4 shares) being disposed off since my return from the vessel, that the day before or two I saw under sale falling down. This being done, I order'd the deeds to be dispatcht; & they, with 26 more, were signed & sealed the last week, on the 29th ult, & are in the hands of one Ford in Bow Lane, well known to Dr. Wood. Upon the whole matter I can only do this: I will dispose of them for you if I can, & as soon as I can, if the demur candedly rises in your selves—If from any ill rumers suggested by others (if they are not fals), I will give you what you have resolved to buy.

However it be, a good country God has made it, and a good Government I hope I and the Adventurers shall make. And so I will end this abrupt letter with my respects to Sir Hen[ry], thy sister, & my ould Esop & Friend, which are very unfeinedly to thy selfe. I close what really I am

Thy faithfull Friend

William Penn.

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[1] Penn had just sent out three Commissioners to look after his interests in Pennsylvania pending his own arrival.

Note I mean by disposeing of them, not that *you* should pay me, but they I dispose of them to—If you are of minde not to proceed. For my friends I love better then my land sale.

W. P.

To the Lady Petty at her house in Piccadille, neer Sackfield Street, London.

We may assume from the fact that neither Lady Petty nor Sir H. Ingoldsby's names appear on the first list of settlers in Pennsylvania that Penn was successful in passing on their shares to others.

Petty no doubt at first looked on the project with some disfavour, since it was bound to absorb some potential English settlers in Ireland under his own scheme for a general 'Transplantation.' Possibly it was the note of caution which he sounds in No. 109 and No. 110, which induced second thoughts to his wife and Sir Henry Ingoldsby. In No. 111, however, he is more hopeful, and gives his own idea of the method to be followed in establishing a new plantation, with a diagram showing the ideal 'lay out' of such a settlement.

No. 112 contains some excellent advice as to the management and development of the new colony, and must have been drawn up for Penn's especial benefit, while No. 113 invites a minute inquiry into the manners and customs of the native Indians.

In No. 114 Petty states the terms on which he himself would be willing to undertake a plantation such as that described above (No. 111), having as its nucleus a town of sixty houses; and finally, in No. 115, there is the draft agreement which I have reproduced at the commencement of this volume forea perpetual lease by Penn to Petty of 78 square miles, or nearly 50,000 acres, abutting upon an unnamed river. The rent to be one hundredth part of the yearly produce. This proposal seems to have been quite outside the ordinary line of business as between Penn and his settlers, for it involved a merely nominal cash payment at the outset, and the yearly rent (instead of being a fixed sum per acre) was to be assessed and paid on the basis of an hundredth part of the produce actually obtained. It may safely be assumed that it went no further.

Petty's name does not figure in the "Short Advertisement" of Pennsylvania (published with map and list of settlers in 1683), and his MSS. leave us in doubt whether any grant was actually secured by him or by his wife. But nearly a century later the point is cleared up in the papers of his great-grandson, William Lord Shelburne. About the year 1777 Shelburne appears to have received information that his ancestor was in fact on the original list of Purchasers in the Surveyor-General's office at Philadelphia, and that as Petty's successor he was still entitled to 5000 acres of ' vacant ' land (if any such was left), 100 acres of ' Liberty ' land, and three ' city lots ' in the capital. In 1778-9 he filed, with the approval of the Surveyor-General, J. Lukens, claims for a lot in High or Market Street, another on Schuylkile or Front Street, and a third on Mulbery or Arch Street—as also for 5000 acres up country, near Tioga on the Susquehanna River.

The city lots presumably were not then built over. Shelburne perhaps had some premonition that they would prove of value, though he can scarcely have guessed that they would be in the very centre of the business portion of the Philadelphia of the future. The War of Independence, however, put an end for the time being to any prospect of obtaining possession. Peace with the United States (negotiated by Shelburne himself as Prime Minister) was signed in 1783, but it was not till 1791 that he renewed his efforts. His eldest son, Lord Wycombe, paid that year a visit to the United States, carrying with him letters of introduction to George Washington and to the numerous friends his father still had on the other side of the Atlantic. Wycombe was also the bearer of a full statement regarding the Philadelphia claims and was charged while in that city to see if anything could be done. His letters show that the municipal authorities were sympathetic, but unable to assist. The lots had, in fact, by this time been ' jumped ' by others and though there was some talk of compensation it does not appear that this was ever received.

No. 107

Notes about New England

Townes in the Province of Masachuset, (conteyning Boston, Hampshire, & Main).

Boston	hath about 1500 Famylyes
Salem	500

Ipswich	hath about	500	Famylyes
Charlestowne		300	
Cambridge		300	
Watertowne		300	
Roxbery		150	
Dorchester		150	
Dedham		150	
Waymouth		150	
Hampton		200	
Salisbury		200	
Hingham		100	
Hull		100	
Dover		100	
Lin (? Lynn)		200	
Manchester		60	
Manham		100	
Haverell		100	
Topsfield		60	
Rowley		200	
Newbery		200	
Portsmouth		300	
Exeter		150	
Kitereen		300	
York		200	
Wells		50	
Chensford		150	
Andover		150	
Concord		200	
Sudbery		150	
———		60	
Medfield		150	
Springfield		100	
Gloster		80	
Marblehead		150	
Redding		200	
Hamersmyth		100	
Malboro		70	
		8180	

There are also about 30 other small Townes omited which conteyn about	900 Famylyes
There are also the other Provinces of Kenecticut, Plymouth, Rode Island & Kinebeck. In all which are estimated to bee	3000
	12080

So as in all New-England there are about:

12,000 Famylyes
100,000 soules
16,000 men fitt for armes.

Shipping belonging to New England, vizt:

Sampson	220 Tun
Sea flowre	180
Blessing	180
Sto	220
Industrye Cutts	100
John Gillam's ship	160
Dat Edwards	130
Jer . . . (?) Cushin	150
2 Hayton's ships, one of	150
the other	100
John Coxes ship	120
Greenaway	100
	1810
[Small shipping *infra*]	9500
[Fishing boats *infra*]	2622
	13,932 tuns

Small shipping under 100 Tun (viz: from 100 to 20) belonging to:

Boston & Salem	150 [ships]
Pescatagua river	20
New London & Swanedge	10
Conecticut River & Rhodes Island	10
	190
[at an average of 50 tons]	9500 [tons]

Fishing Boats under 10 Tun (most whereof are about 6 tons) belonging to:

Boston	50
Salem & Marblehead	150
Sholes Island in Pescatagua river, Ipswich & Rowley	80
Yorke or Gorgrina[1]	10
Cape Porpus	6
Winter Harbor	20
Black Point	20
Spurwink Island	15
Richmonds Island	30
Casco Bay Island	30
Cape Bowa Naygur (?)	12
Dr. Arnival's Cove	10
	437[2]
[at an average of 6 tons]	2622 [tons]

In all New England There is about 14,000 [tons] of ships & boates.

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[1] It was intended to call the original settlement at York or Agamenticus, after Gorges, by the name of Gorgeana (Osgood, *American Colonies in the 17th Century*).

[2] This figure should be 433.

Iron works

At Linne	are	2
Concord		1
Topsfield		1
New haven		1
		5 Iron workes

The *Principall Merchants* are: Mr. William Browne of Salem, Capt. Cutwin.

At Boston. Mr. Leveret, Governor—Mr. Ezekia Usher, Mr. Sam Shimpton, Mr. Peter Leyet, Mr. Jo. Hall, Mr. Tho Deane, Capt. Wm. Davis, Major Clarke.

In Pescatagua River are: Richard John Cutt, Major Waldron, Mr. Shiplye, Mr. Pinchon, Mr. Broadstreet.

These 15 merchants are worth from 20000£ to 5000£ each.

In Boston Province are about 500 others which are worth each 3000£ or thereabouts.

So as: 15 merchants are worth	150000£
500 others are worth	1500,000£
515 merchants are worth	1650,000£

Eminent ministers.

In Boston are Mr. Thatcher, Mr. Oxenbridge[1] (Rich as the rest of the merchants), Mr. John Allen.

Cambridge: Mr. Oakes, Dr. Hoare (President of the University).

Watertowne: Mr. Sherman.

Sudbury: Mr. Browne (Episc).

Lin: Mr. Whylinge.

Salem: Mr. Higenson.[2]

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[1] John Oxenbridge (1608-1674), sometime Fellow of Eton College. He was ejected in 1660, and eventually settled at Boston.

[2] John Higginson (1616-1708), son of the better known Francis Higginson, whom he had accompanied to New England when a boy.

Marblehead: Mr. Waltham.
Ipswich: Mr. Cobbert, Mr. Hubberd, Mr. Rogers.
Rowley: Mr. Philips.
Newbury: Mr. Woodbridge, Mr. Packer.
Haverill: Mr. Ward.
Salisbury: Mr. Wheelwright: Mr. Seaborne Cotton Hampton.
Portsmouth: Mr. Moody.
Roxbury: Mr. Elliot[1] (that translated the bible into Indian).

Rivers & Harbours on the Coast.

Stamford, Stratford, Milford, Fairfield, Newhaven (within Conecticut), London Harbour, Naragansett R, Road Island H, Cape Cod H, Barnstaple H, Plimouth R, Scituate, Charles River at Boston, Marble Head H, Salem R, Bass R, Cape Ann H, Ipswich R, Newbury R, Merimack at Salisbury, Hampton River, Pescatagua, Acomenticus at York or Gorgiana, Cape Porpus R, Kenaybanck [Kennebunk] R, Wells R, Saco R, Black Point R.H., Spurnwink R, Richmonds Island H, Casco Bay (wherein are about 300 Islands), Hope Harbour, Sagadehoe, Kymebech [Kennebec?].

Islands.

Long Island, neere New Yorke. Sheter [? Staten] Island, Gardivers [? Garners] Is, Fishers Is, Plum Is, Block Is, Rhoade Is, Elizabeth Is, Martin's Vineyard, Stugecthis Is, Nantucketts Is—(These all lye Southwards of Cape Cod). Brewster's Island, severall others within the Bay, Baker Island & others before Salem Harbour. Cape Ann's Is, Plum Is. Isles of Pescatagua R called the Schoales: The great Island of Pescatagua, Champernoon's Is, Boon Is, Richmonds Is, Casco Bay (300 Islands).

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[1] The Rev. John Eliot, missionary and 'apostle' to the Indians.

Men who have been actually soldiers.

Mr. Leverett,[1] the Present Governor, has been a Capt. in England.

Major Denison[2] was long since in the Low-Countryes.

Men like to the Artillery men are: Major Willard, Major Hawthorne, John Winthrop,[3] James Winthrop, Major Winslow,[4] Governor of Plymouth.

Present Magistrates.

John Leveret, Governor.

Samuell Simons, deputy governor.

Mr. Russell,[5] Treasurer.

Mr. Ranson, Secretary of State als Register. Major Hawthorne, Mr. Damfort, Mr. Willard, Mr. Pincheon, Mr. Edw. Ting, Major Clarke, Major Broadstreet, Major Denison, Capt. Gookin, Mr. Stoton.

Merchants and others of London, Trading & Corresponding with New England are

Dr. Owen (corresponding with New England), Mr. John Harwood of Mile end, Mr. William & Mr. Benjamin Peake, Mr. Ashunt in Aldersgate Street, Mr. Richard Glover, Mr. Wooley neere Algate, who sells New England bookes.

The most popular men are:

Leveret, Denison, Broadstreet, Clarke.

Ministers: Thatcher, Oxenbridge, Higginson.

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[1] John Leverett (1616-1679). He had fought on the Parliamentary side in England, and was knighted by Charles II in 1676.

[2] Daniel Denison (1613-1682). He held various offices in the administration, and became Commander-in-Chief of the troops in Massachusetts.

[3] John Winthrop the younger (1606-1676), Governor of Connecticut. He was the son of John Winthrop the elder.

[4] Josiah Winslow (1629-1680), only son of Edward Winslow (d. 1655), who had been for many years Governor of Plymouth.

[5] Richard Russell (1612-1674). He was for some years Speaker of the House, and from 1644 till his death Treasurer of the colony.

Physicians: Elisha Cooke, Mr. Broadstreet, Mr. Chickerine.

Mathematicians: Mr. Woodward A—— B——.

Eminent Sectaryes live at Providence, Road Is, Warwyck.

Miscellany observations concerning New England vizt:

1. Canvas, Cordage, Twine, Netts, Lead, Cloath, fine Linen brought from England.
2. Artisans earne 3*s*. per Diem; Labourers, in Winter 2*s*., Summer 3*s*.
3. No Ordnance Cast.
4. A Danceing school formerly, but now none.
5. Fenceing taught.
6. McCarthy a Periwig-maker.
7. The ministers at Boston, Salem and Ipswich are paid in mony, elsewhere in provisions.
8. At Boston the ministers are upon voluntary Contribution, but in small Townes by assessment.
9. No Beggars in the whole Country.
10. But 2 executed for Theft.
11. Severall for Homicide, especially wenches for killing Bastards.
12. Adultery is Death by the Law, but scarce ever executed.
13. The best House in Boston is of brick, 4 storyes high & 4 roomes on a floore; & there are not in Boston 20 Houses which have 10 Roomes apeece in them, nor are there anywhere better Houses than in Boston.
14. The poorest Houses have ground Roomes & Lofts, & most have Cellars.
15. The Militia of Boston is about 1200 men.
16. All the Horse of the Country are scarse 600 or Ten Troopes.
17. The Province of Hampshire & Mayne are governd by the Bostoners.
18. The Towneships are set out by admeasurment & marks.
19. Every Towne wherein are 40 Freemen, send a

Member to the Generall Court & smaller Townes joyne for the same.

20. The Generall Court or House of Commons meet on the last Wensday of Easter Terme yearely, & disolves when Itself pleases.

21. The Governor & Magistrate are Like the Upper House, wherein the Governor hath 2 voices.

22. The Boston or Masachusets Government, with Hampshire & Mayne, are estimated to bee $\frac{3}{4}$ of the wealth & power of the whole.

23. $\frac{1}{2}$ the Province of Mayne is wast.

24. They Invite the Indians to see them Muster in Armes, but never suffer them to handle Armes.

25. There are Bookes printed of the New-England Lawes. A book of New England written by Joselyn; another called 'Morton's Memoriall.'

26. Sir Hen. Vaine was governor about anno 1631.

27. The 1st Patent about 1620, next 1627. The chief Transmigration was between 1631 and 1641.

28. An Elector for the Assembly or freeman must bee Orthodox, above 20 yeares, worth about 200£.

29. The Governor &c. chosen by all the Freemen, whose votes the Burgesses bring to the Assembly.

30. They take an oath of fidelity to the Government, none to the King. Writts run in the Kings Name. They take also another oath of Office.

31. A Prison & Church within every Towneship.

32. The Governor & 3 Magistrates make a Court for Tryall of Causes at Boston, but elsewhere the Governor & 2 do the same, who goe Circuit like Judges.

33. Every man Pleads his owne Cause, or gets a friend.

34. Little Musick usd, no musicians by Trade.

35. One Mr. Elliot translated the Bible into Indian.

36. Paper hath been made in New England.

37. The Sectaryes at Road Island use extream Lyberty & live quietly enough.

38. The Cloth made in New England, not worth more than 4*s*. per yard, & the best Linnen not 2*s*. 6*d*.

39. There is a Mint at Boston, whereof one Hull a Goldsmith is Master, who is also a Merchant.

40. No Allum no Copperas made there.

41. Much black-lead found, but no Common Lead.

42. They say there is Copper in Hampshire, but much in Nova Scotia.

43. No Salt made by the Sun, but by boyling of water, or Salt upon Salt.

44. Good Beavor hats made.

45. The Marts are far from the water side.

46. Boston hath 3 Churches, not Parishes.

(*Endorsed.* "Notes about New England. Taken 4 February 1674/5 by Sir William Petty & Dr. Taylor from Mr. Frost & Mr. Bartholemew.")

No. 108

MEMORANDUM: NEW ENGLAND

Within The Colony of the Massachusetts Bay are about forty Towns, in every of which generally there is a foot Company of listed Soldiers.

In Boston there are eight Companys, In Salem two, & in some other Towns there may be two.

There are Six or Seaven Troops of Horse.

From their North to South Bounds is by Land betwixt forty & fifty miles, but by Sea no more than ten Leagues.

Not one Acre of ten or twenty in many places manurable.

Comodities imported from England may amount to forty or fifty thousand pounds yearly.

They account all generally from Sixteen to Sixty, that are healthfull & strong Bodies, both householders and Servants, fitt to bear Arms; except Negroes & Slaves whom they arme not.

There are 500 Whites born there yearly & three hundred marriages.

In the Colony of Plymouth The number of listed men, from 16 years of age to sixty, are about twelve hundred.

In seven years have been born eight hundred Whites.

Four hundred & fifty marriages within the same time.

In Rhode Island

The Militia consists of ten Companies of foot.

They have above 500 Planters and above five hundred men besides.

Of Whites & Blacks (of the latter there are very few) about two hundred born in a year.

About 50 marriages; about four hundred & fifty five Burialls in Seaven yeares.

In Conecticut Colony

The Militia consists in 2507, all from 16 to 60 being obliged to bear Armes.

In the year 1671 the numbers of men were 2050; in the year 1676, 2303; in the year 1677, 2362; in the year 1678—2507.

The Estates amount to 110,788£ St.

The Houses & Barnes not valued.

In New Hampshire The numbers of Horse & Foot are about four hundred & fifty.

In the Province of Maine, double the number of the Militia in New Hampshire.

(*Endorsed.* "Some Remarques of the people of New England, drawne from Papers sent from thence.")

No. 109

QUESTIONS CONCERNING AMERICAN PLANTATIONS

Whether It bee better to transplant out of England in Ireland or America?

Suppositions

(i)	That an acre of land in Ireland is worth 40 shill.	
(ii)	Suppose 10 men can cleere —— in one yeere in America to bee fit for plough or cattle.	
(iii)	Suppose their passage bee at 5£ each	50£
	The passage of their wives & children	50
	Their tooles	20
(iv)	300 days worke for each man in the yeare, at 12 pence each per diem	150
	Of their wives & children	50
	Overplus of expence in clothes &c.	50
	[Total outlay for one year]	370
		½ 185£

If they cleere lesse than 185 acres for the yeere, there is losse,[1] which is given for liberty in Religion & Government.

2nd Question

Suppose there bee 10^{m} people, men, women & children, & 40 million [2] of acres of Land. What is the most convenient Method for their plantation?

3rd Question

Suppose England will beare as good Tobacco as Virginia, & each at 1*d*. per pound. Suppose the

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[1] On the assumption that the land in America (when cleared) is of the same value as in Ireland, *i.e.*, £2 per acre.

[2] In supposing this figure Petty probably had Pennsylvania in mind, though the true acreage of William Penn's grant was nearer thirty million acres.

King's duty on the Virginian to bee 2*d*., freight 1½*d*. & pound[age] (?) ½, in all 4*d*. *Q*. How much duty might bee imposd on the English to the advantage of King & Country?

4th Question

Suppose England itself to bee underpeopld, & Ireland more [so], & America almost wast. *Q*. What danger it is to Let people go out of England into Ireland or America, and to which most? and the measures thereof.

(*Endorsed*. "4 questions about plantations in America. 1685.")

No. 110

The Charge of 5000 acres in Pensilvania, vizt:

	£
There is to be paid to Mr. William Penn, Patentee, £100.	
More to him a penny per acre, which is £20 16*s*. 8*d*. per annum,[1] worth about	300
There must bee paid for cleering at least 1000 of the said 5000 acres, after the rate of £5 per acre, which is according to the rate that 2 men between October & Spring may cleer Land enough to yield 20 quarters or 160 bushells of corne	5000
For the passage of 1000 people, wherewith to plant the said 5000 acres of Land .	4500
For the losse of 4 months time in preparing for & makeing the said passage at 4£ per head, one with another	4000
For the extraordinary charge of victualls & cloaths for the first yeare of the said 1000	

---

[1] Five thousand acres was the normal share in the new colony. This is explained by Penn in the 'Description' appended to his map of Pennsylvania issued in 1681, but from the same document it appears that all but 50*s*. of the yearly rent (£20 16*s*. 8*d*.) was sold off in consideration of the initial payment of £100.

	£
Persons, which is at least double to the same in England or Ireland	4000
For 200 Howses wherein to lodg the said 1000 Persons, at 20£ per howse	4000
For fencing the said 5000 acres, & for cleering 4000 of the said 5000 acres, so as to make it fit for graseing of Cattle at about 20*s*. per acre	4000
All which amounts to neer 5£ 4*s*. per acre	25800£
The value of the Cattle requisite to stock the said 5000 acres	4300
	30100£

The whole is 30^{m}£ whereof the Patentee hath but 300£: viz, $\frac{1}{100}$ part.

Returns or rents

The Cattle & 4000 acres of pasture worth per annum	3000
The 200 howses & gardens & public works	800
The 1000 acres of arable	1500
	4300[1]
Purchase at 7 years	30100

(*Endorsed*. "The charge of a share of 5000 acres in Pensilvania.")

No. 111

American Planting[2]

Suppose 40 million of acres in America & but 10^{m} people, men women & children. The questions are:

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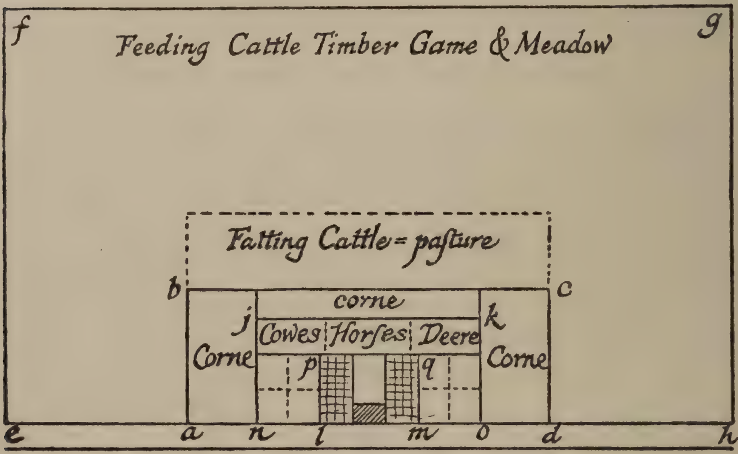
[1] It will be noticed that Petty's addition is at fault. The correct figure (£5,300) at seven years' purchase, would show a profit of £7,000 instead of an equilibrium.

[2] This paper is an answer to the second of the four questions propounded in No. 108 *supra*.

1. How many acres will feed 10m mouthes & how to be situated?
2. How many of them shall bee for houses & publiq places?
3. How many for private gardens & fruites?
4. How many for orchards & kitchin?
5. How many for horses & milch cowes?
6. How many for corne?
7. How many for cattle of each species?
8. How each should be situated?



To the first: That 30^{m} acres, which is 47 square miles, may suffice for cattle and corne, with 2 miles square for great parks & the kitchin, one mile square for private gardens, publiq places & houseing. In all 50 square miles, 10 miles long upon a river, & 5 miles backwards in the forme annexed.[1] And when there bee 20^{m} people To plant as much more on the other side of the River.

3 acres of Land is enough for each head.[2] 100 square feet is enough for their houseing. 7 head enough for each family at a medium. Wherefore

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[1] *Cf.* Diagram.

[2] *Cf.* Introduction, xxxvii.

10^{m} people must make 1428 familyes, and require 1000^{m} of square feet, which makes 18½ acres.

32^{m} acres will bee enclosd & fortifyd for 3200£. 64^{m} acres will bee enclosd & fortifyd for 5000£.

A wharfe of 1000 feet [? l to m]. 2 side walks of 1000 feet. 60 howses upon the fortifyed wharf. A ditch about a.b.c.d. of 14 miles. A ditch about e.f.g.h. of 25 [? 30] miles.

n.j.k.o. [a boundary] of 9½ miles.
l.m.p.q. of 2 miles.

The diagram above is reproduced (on a smaller scale) from a very rough sketch in the original MS. It is evidently intended to show the area described above, 10 miles in length along a river (? the Delaware) and 5 miles in breadth. The largest rectangle (efgh) shows the outer limits of the plantation (25 or 30 miles); the next (a b c d) an area apparently 5 miles by 2 to include all the land under tillage; the third (n j k o) say 3 miles by 1¾, the homesteads and their appurtenances, and finally l p q m, one mile square, the private gardens, public places, and the 60 houses of which the settlement was to consist.

Advices about American plantations, viz:

1. That the Indian may not live within the plantation, but that markets of furres, deere & foule, bee kept neere the Line.
2. That the English may buy Indian girles of under 7 yeares old and use them as wives, even with polygamy regulated by authority.
3. That no youth of between 18 & 58 yeares old, nor woman of between 16 & 41 yeares old, bee unmaryed, without manifest impediment allowed by the magistrate.
4. That there bee an exact accompt of the Fruges.

(*Endorsed.* "Of American planting 1685.")

No. 112

General Cautions concerning Pensylvania

1. Since the whole Province, at $\frac{1}{2}$ penny rent per annum, will yield 100^{m}£ per annum, make hast to let it at that rate, or at $\frac{1}{100}$ part of the growth of Corne & Cattle.[1]

2. Rely upon no security but the Emprovement & stock upon the Land, & not from the Emprisonment of debtors.

3. There need be no beggars or theeves. Wherefore prevent & punish the same by stripes, extra labor; but not by Imprisonment.

4. Decline the use of gold & silver for mony, but use small brasse pieces, Printd Parchment, & bank bookes.

5. Let every family have in it a Teeming woman of between 16 & 42 yeares old, & not more than 5 heads.

6. Enjoyne all men to keep Journalls of their receipts & payments.

7. Keep an exact accompt of the people, their births, burialls, mariages, arrivals &c.

8. Draw no man into Covenants, but [those] you know may bee well performd with ordinary endeavors.

9. Let all men bee settld to their employments within a day after landing.

10. Discourage the Learning of lattine & greek, and of University learning; but promote arithmetic & measuring & drawing.

11. Avoyd Stragling plantations.

12. Promote printing & postage.

13. Set up betimes a registry for contracts & obligations.

14. Let all men of between 18 and 58 pay for the keeping of all children that are borne.

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[1] As Petty proposes in his own case in No. 114 *infra*.

15. Let but one sermon be preached in all the religious Congregations.

16. Forbid foraine Trafficq (but for absolute necessity) for —— yeares.

17. Let no publiq offices bee profitable.

18. Let matters of fact which cannot bee decided, bee left to Lott.

19. Admit the Native women into freedome.

20. Let there bee common Nurseryes, Infirmaryes, hospitalls & schools.

(*Endorsed.* "Pensylvania.")

No. 113

QUAERIES CONCERNING THE NATURE OF THE NATIVES OF PENSILVANIA vizt:

1. Suppose there bee 1000 of them, within a certain scope of ground. *Q.* How many of them are under 5 yeares old? How many between 5 & 10, 10 & 15, 15 & 25, 25 & 35, 35 & 45, 45 & 55, 55 & 65, 65 & 75, & how many above 75?

2. How many are abortive & stillborne; that is to say borne at the end of the 7th & the end of the 9th month, or between 220 & 250 dayes.

3. What is the proportion between their males & Females?

4. At what age have young women usually their first child? and after what age do they beare none?

5. At what age do women's menstrua leave them?

6. What is the common age of that whole 1000 people?

7. What is the stature of the Tallest and shortest man & woman of the said 1000?

8. What is the weight?

9. What is the stature & weight at a medium of men & women distinctly, which are above 20 years old?

10. How long do their children suck? and what food do they give them in the first yeare, besides the mother's milk?

11. How many women dye of Labour; that is to say, within 48 Howers before or 48 Howers after their child's birth?

12. How many in Child-bed, or within 30 days after Child-Birth?

13. What are their most usuall acute Diseases, and Chronical?

14. What difference between the smale pox there and in England,[1] vizt: How many of the said 1000 ever had it? and how many per cent. dye of those who have it?

15. In the said 1000, how many have red, yellow, black, chessnut, light-browne, and white haire?

16. What difference in the collour of their eyes?

17. To how many differences their Lips, Noses, and outlines of their Faces may bee reduc'd?

18. How many Children have the most fruitfull women, and at what distances?

19. How many dye per cent. per annum?

Other quaeries concerning their policy, Language and Habitations

1. What is the true meaning of 'King' amongst them? hath hee power over Life and Death? and over the Plantations and Goods of his subjects?

2. By what Title doth hee clayme his Power, as oldest, strongest, &c.? as the eldest of his race &c.?

3. How many subjects, men, women & children, hath a King commonly there?

4. How many People speeke the same Language?

5. What are Crimes, publiq or private, amongst them?

6. What are their formes of Judicature, and ways of punishment?

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[1] One third of Penn's original company of settlers died of small pox on the voyage out in 1682.

Of their Religion and Marriages

1. What opinion have they of themselves after Death?

2. For what Cawses are they made more or less miserable than in this Life?

3. What is the Condition of young Children after Death?

4. Do they believe that one and the same God made the Sun, Moone, and Stars, this Globe of the Earth, mankind, and all animals that dwell upon the Earth, in the sea and in the ayre?

5. Do they beleive that God can raise men from Death to Life? Make a man a woman? dry up the sea? make the sunne stand still? remove the greatest mountaines from one place to an other, at any future time prefixt?

6. Do they beleive that God beareth any proportion unto a man? or hath any Passions & affections like to those of men? vizt: Love, Hatred, Joy, Sorrow, feare, hopes, glory, shame, &c.

7. Do they beleive that God made Heaven and Earth and Man and all Creatures for any use or End, preconceived or designed before their making?

8. Do they beleive that God heareth & considereth the prayers & desires of men? and that hee is delighted or grieved with any actions that men can performe? and that hee hath appointed how hee will bee served or worshiped by all his Creatures? and how by all mankind, and by each species of man in particular?

9. What are the Rules of marriage? What minglings of Male and Female are sins against God, or crimes against their Magistracy? and the same of Man-slaughters, and taking away one an others goods.

10. By what seeming miracles or extraordinary productions, do their Priests bring them to Religion?

11. What are their signes of worship towards God?

12. What Religious Assemblys, Formes of prayers, gestures and significant Serimonys do they use?

13. What is their way of buriall, mourning for, & remembring the dead?
14. What Religious Remedys do they use against publiq Calamitys?

Of their Oeconomy & exercises & Learning, vizt:

1. Of what materialls do they build their Howses? and of how many days Labour doth their best and worst Howse consist?
2. What eatable annimals, fish & foule, have they? what Herbs, fruits, seeds & Roots?
3. What are their severall Drinks?
4. Of what materialls are their necessary Cloaths?
5. What is their Musick, Dancing, & exercises of pleasure?
6. What are their Weapons & Instruments of War? and the manner of their fighting in Great Parties or Single Combat?
7. What extraordinary performances have they in swiming, shooting, leaping, dancing?
8. How is the worke of provision for food & Cloaths divided between the Males & Females?
9. What are the Tools, Utensils, and Howsehold stuff which they use?
10. What is their mony or Common measure of exchange?
11. What works of Ornament have they, not easily imitatable by the English?
12. Do they understand Gunpowder?
13. How many simples do they use in Medicine? and how do they apply them? and what cures can they certainly do?
14. Do they think the Condition of the Europeans happyer than their owne? and whether it bee better to have many or few things necessary?
15. What is their manner and rate of selling Lands to the English?
16. Is there much Lying and Fraude amongst them?

(*Endorsed.* "Concerning the Natives of Pensilvania 1686.")

No. 114

A PROPOSALL CONCERNING AMERICAN PLANTATIONS. vizt:

1. A B will inclose 40^{m} acres of Land, lying length ways upon a navigable River, with 4 [other] Divisions and surrounds, one within another makeing in all above 50 English miles of good fence.

2. Hee will wall in a Towne of 120 acres, will build within the same 60 houses, vizt: 30 on each side of the street. The end of which street shall abut upon the River, where shall bee a wharfe, Kay, Crane and Boate. Each house shall have a small garden or outlet, and there shall bee withal 2 common large kitchin gardens planted with Trees, Rootes, herbs, Ligumes &c., fit to furnish something for the Table every day in the yeare.

3. Will make a Church, Court howse, and Market Howse in some convenient place.

4. Will build 15 dary Howses at convenient places, without the towne, but within the Inclosures aforementioned.

5. Will, within the towne wall, make a well, Mill, Malt howse, Bake Howse, Brew howse, distilling Howse, Wash howse, slaughter howse & salting howse for fish & flesh; with places for makeing of oyle, soap & Candles, with least Annoyance.

6. Will stock the Inhabitants of the said 75 howses (which probably will bee 450 in number) with 120 milch Cowes, 10 yoake of working oxen, 60 other Cattle, 1000 sheep & with Poltry proportionable to the village.

7. Will cleere & plant 15 acres of garden, 120 for Tillage of Corne, with meadow proportionable for the number of Cattle.

8. Will furnish mony to every Planter, to the value of his substance.

He expecteth for the premisses as followeth, vizt:

1. That in each of the first 75 familys there bee a teeming woman of between 16 and 30 year old.

2. That 300 of the whole 450 abovementioned, bee men or women that understand the breeding of cattle, the practis of a dairy, tillage of corne, kitchin gardenage, makeing of Brick & Lime, fishing, dressing of leather, makeing of woolen cloath, Linnen & Ropes, earthenware and glasse, working in wood, Iron and other usefull metalls.

3. That each head bee able to pay for their passage, and have Ten pound per head over & above to furnish themselves with howsehold & goods, Cloaths, utencills, tools and provisions, for the first yeare after their Landing.

4. That all & every of the said Persons shall pay unto the said A B, for the common and particular use of the said Land, arrable, meadow, Pasture and Gardenage, cleered, fenced built & emproved as aforesaid for ever, $\frac{1}{3}$ part of the increase which ariseth out of their Lands, Labor and stock, vizt: of the children, Cattle, & fish, as also of their Corne and fruit; which the said A B will from time to time apply with the Tennants, to the plantation of the said 40 thousand acres, untill 10 thousand head of mankind bee planted thereupon. At which time the whole Land shall bee particularly set out by bounds & meers, according to the number of heads and their qualifications.

(*Endorsed.* "A Proposall for planting 40^{m} acres in America.")

No. 115

An Agreement between Penn & Petty about a Colony in Pensylvania. 1686

Penn doth devise to Petty, in Consideration of 5*s*., a quadrangular peece of Land Lying 12 English Miles upon the river of ——, and 6½ miles broad upwards into the Land, forever; Yeelding & paying for the same one grayne of wheate yearely, together with one hundredth part of all Colts, Calves, Lambs & pigs, as also one hundredth part of all the Wheate, Rye, barly, Rice, Oates & pease, which shall bee gotten & producd out of the said lands forever. To be taken from time to time from & out of the said lands by the said Pen or his assignees, in the same manner as Tythes are now taken & Collected in England.

XVIII

FORESTRY

(116) Proposal for Timber and Bounding of Land—(117) Forests—(118) Enclosing Commons.

FORESTRY

THE three papers in this chapter deal with Forests and Wastes. The first (No. 116) relates to Ireland, where Petty was intimately interested in the conservation of timber, for he had established in South Kerry, in the neighbourhood of Kenmare, a number of iron furnaces and forges which were entirely dependent for their continuance on the local supplies of charcoal.

It has been asserted, by Macaulay amongst others, that Petty found this region densely clothed with woods and left it completely denuded. The Down Survey maps prove the first part of this statement to be erroneous, for these maps were made some time before Petty installed his first smelting furnace, and show the areas under wood to have been at that time few and far between. It is true that the conservation of isolated woods was then (as now) a matter of considerable difficulty in Ireland, but there is evidence that both Petty and his immediate successors made every effort to preserve them, and to replace by fresh planting those that were cut down. Scant success, however, attended these endeavours. Nor were the attempts at reafforestation made a century later by William Lord Shelburne (the first Marquis of Lansdowne), able to withstand for long the depredatory tendencies of man and beast in this locality.

In the same connection it may here be observed that Hull (Introduction, xxv) and others are wrong in saying that the iron ore smelted round Kenmare was imported. The Petty MSS. relating to these ironworks show that it was found on the spot, though later on in the eighteenth century the supplies became exhausted and there is no iron in the country to-day. The native ore was, however, generally mixed in the proportion of 5 to 1 with red ore from Wales, in order (as it is explained) to make the metal 'less brittle.'

It is interesting to note that Petty was an advocate of 'Arboriculture' (*i.e.*, the cultivation of single trees not more than forty to the acre) as opposed to the modern method of 'Silviculture' (or planting in mass), which he considered wasteful. This may perhaps be explained by the fact that it was less important then than it is now to grow 'clean' timber from which to make planks. Crooked timber, especially oak, was, in fact, often specially valuable for the 'knees' etc. required in shipbuilding.

No. 117 takes us back to England, where it is proposed to deforest half the royal forests, and to let or sell the land so cleared. In the portion remaining in the King's hands it is suggested that Trees and Flax should be planted in sufficient quantities to ensure in future years a full supply of timber and sail cloth for the King's Navy—the woods to be on an eighty years' rotation. The royal forests were in Petty's day under the control of a Surveyor-General. He proposes to transfer this function to a body of Commissioners—an administrative reform which actually took place in 1810.

From the paper which follows it may be seen that these proposals did not emanate from Petty, for in No. 118 (*Notes upon the design of inclosing commons*) a series of objections to them is set forth, and it is asserted that they could only be successful if measures were first taken for the 'multiplication' of the population. This was, as we have already seen, Petty's favourite panacea. It is worthy of remark that, although recognizing the increase in productivity which was effected by enclosure, Petty claims that there was already an excess of food for the existing population, while he asserts that the idea of enclosure was so 'odious to the world' that it involved 'martyrdom' for those who might venture to advance it.

No. 116

Proposall for Timber and Bounding of Land: 8 Feb. 1672-3

I conceive and estimate that 400^{m} Trees afford 3 trees to bee placed at every survey-station of all the Lands in Ireland, which in 50 yeares may grow to a Tun of Timber; and that 5 times as many more may be conveniently planted within the said 50 yeares: vizt: 200^{m} every 5 years.

The uses of wood in Ireland are (1) For fuell for Iron works, (2) for fences, (3) shelter and shade,

(4) for Timber for housing and shipping, (5) for hoopes and cask, (6) ornament, (7) for boundaryes.

The Woods of Ireland, with the help of Norway may last yet 50 yeares.

Timber Nursery (?) in Ireland is under 10^{m} tun per annum.

Woods, viz: *Sylvae*, is not the best way for Timber, and wasteth lands.

If planting of a Tree cost but 3 pence, and Timber bee worth 10*s*. per tun, there is a profitt.

There is profitt in this proposall, reckning interest upon interest for 5 yeares, doubling the principall every ten yeares by progression.

Woods that will grow in Ireland are: Oak, Ash, Birch, yew, Witch hazell, Willow alder, Firres, Walnutt. (Q) Elme, Beech.

No. 117

Forests &c.

Whereas shipping is the safety, honor, and profit of England:

Whereas the soile of England produceth better Timber and plank for shipping then other countryes:

Whereas [the] Timber of England especially for great ships is manifestly decay'd and will wholly fail within —— years:

Whereas England is underpeopl'd and contayneth more land then is necessary for the food of its inhabitants, so as a sufficient quantity thereof may be spared for Timber and Hemp:

Whereas England contayneth too many forests and chases, to the prejudice and damage of the people and the common good:

(1) It is hereby propos'd that deforesting many of his Majesty's forests and chases would make a perpetuall provision of Timber and hemp, sufficient for

all the shipping needfull in England according to the state thereof for the 20 years last past, or even to the double thereof if need require.

(2) That besides securing the said necessary Navall provision to all posterity, the deforestation aforesaid may within —— yeares yield a profit to the King of about —— thousand pounds per annum more then at present.

As to the said deforestation, It is humbly propounded:

1. That the King may have and enclose halfe the land of each forest and chase, by number of acres or by choice, but to be cutt off by one straight line (the outbounds, highwayes and rivers making the other bounds), or by lot or by value.

2. That the other halfe bee divided by bounds and meeres among the Commoners in the whole, according to just proportions as they had in the whole; reserving to the King the Timber trees of above 12 inches diameter which grow in the Commoners halfe.

3. That the enclosures within the Commons halfe bee not lesse then 40 acres, and that lesse parcells bee held in comon, or by proportionable rents, or sold outright to neighbors (?).

4. That out of the King's halfe bee taken as many acres of the best lands fit for timber and hemp, as will answer the calculation and proportion of the whole provision in each particular forest.

5. That what is allott'd for Timber bee divided from what is allott'd for flax.

6. That what is allott'd for Timber bee divided into 80 parcells, whereof $\frac{1}{80}$ part is to bee planted every yeare successively, at the rate of 40 trees to each acre.

7. That in lieu of the plants which shall fail of growth, Two others bee set, one in the roome of what fayld, and the other in the hedgerowes of the land not allott'd for timber. And if any Tree of the second yeares plantation faile, one bee set in the same place

and 2 in the hedgerowes aforesaid, and so forward to the 10th yeare's growth.

8. That as much land bee planted with hemp the first yeare as may probably produce $\frac{1}{10}$ of the whole provision; and the second yeare as much as will repaire the defect of the first yeare, and another tenth; and so forwards till the 10th yeare and till the whole bee done.

9. That the King may, instead of his forest land, plant the like number of acres as aforesaid with timber and hemp, on other lands whose soile and situation is better for ship-timber.

10. That —— Commissioners bee appointed under the Great Seele to set out to the King and Commoners their respective shares, and to oversee and direct the King's plantations of Timber and hemp, and to arrent his overplus lands, and to treate with Undertakers about the premises, and for the full delivery of Timber into his Majesty's yards, and of flax and saile cloth into his Stores, for ever, out of the profits of the said deforested lands onely, without other effects after the first —— yeares of this undertaking.

No. 118

INCLOSING COMMONS

1. There are in England and Wales about 30 million of acres, which being well improved, would feed 10 million of eaters; whereas there now wants about $\frac{1}{3}$ of that number, and consequently there is already too much land.

2. It is said that $\frac{1}{15}$th part of all the Lands in England are held in common (viz, 2 million [acres]), the incloseing whereof would make the same equivalent to 3 millions, and thereby add a million to what there is already, which as aforesaid is already to much.

3. The present state of Religion, and the under-

peopleing of Ireland, will make a greater superfluity of Lands in England then now is, whereunto the enormous growth of the Citty of London will contribute.

4. The drayning of fenns, the planting of clover grass, and the bringing cattle out of Ireland, are equivalent to encreasing of Land in England, and therefore not grateful designes. Neither will the enclosing of Commons be, because as aforesaid it amounts to the increasing of lands.

5. Wherefore a designe of multiplying of people ought to precede all designs of multiplying Land.

More particular Objections

1. There appears no particular of the Forrests, Chases, Parks, Commons and waste which may be brought under this designe; without the knowledge whereof no Act can bee framed to the best Advantage.

2. There appears no grounds why the King should have half the Lands wherein hee hath commonage, and why the Lords of Mannors should have $\frac{1}{5}$.

3. There is no mention whether the said $\frac{1}{2}$ and $\frac{1}{5}$ should bee set out in quantity or by value; nor how equilisations of the same should bee made, by Lot or otherwise. Much less how, by whom, and at whose charge, the share of each commoner should bee adjudgd and sett out.

4. There is no estimat made of the number of acres (with their quality and scituation) which should bee applyed to Timber and Hemp; much lesse how many other acres should bee allowed for the said planting of Timber and Hemp. Much lesse are the reasons sett downe whereupon those propositions should bee grounded.

5. There is but a grosse mention how the King's Lands, over and above what is applyed to Timber and Hemp, should bee disposed of.

6. There needs no consideration of a Bank for the King, untill the King's Lands bee perfectly setled:

vizt: applyed to Timber and Hemp, and let to farme for rents and emprovements.

Other considerations concerning Timber vizt:

1. The greatest use of timber will be in or neer the Citty of London, for Howseing, Shipping, and all other uses.

2. It is supposd that 6400 acres of the fittest Lands for Timber, lying upon the Banks of the Thames, half of one side and half of the other, in ten parcells each of a mile square, would more comodiously answer the provision of Timber then to plant the same by Contract with the King upon his Enclosed Forrest &c. Memorandum. That allowing 30^{m}£ for hemp and 120^{m}£ for saile Cloath for the use of The Navy, were no just proportions.

Qre. Whether the exemption of Lands from Tyth bee a sufficient Incouragement for planting of hemp in England, above the bringing of it from East land with English Commoditys?

There is little hopes for an Ingenious Gentleman's makeing any considerable benefit upon such a hard bargain for planting of Timber as the King's officers may drive with him. Besides such a Bargain and Designe is fitter for Clownes, that can neither write nor read, then for Persons of better qualifications.

Tho the designe of Inclosing of Commons bee never so good in itself, yet the name thereof is so odious to the world, that no man will suffer that martyredome without an assurance of far greater rewards then appear in the proposall.

(*Endorsed.* " Notes upon the designes of enclosing comons and planting timber and hemp: 1685.")

XIX

PUMPS

(119) A Method for the Raising of Water—(120) Raising Water.

PUMPS

THIS subject figures both in the *Catalogue of Essays* 1685 (No. 159, "Of Pumps & Water Engines"), and in the *Catalogus Scriptorum* 1686 (No. 160, "The Several Sorts of Pumps").

The two papers which follow are printed as written, though they contain some obvious mistakes in calculation, while the cost per ton of water raised, as suggested in the first, seems to be considerably smaller than that given in the second document.

NO. 119

A METHOD FOR THE RAISING OF WATER WITH CERTAINTY AND CONSTANCY, IN ANY QUANTITY, AND UNTO ANY HIGHT ASSIGNED vizt:

1. To raise the said water 100 foot, under 6*d.* per tunn; and 200 foot, under 11*d.* per tunn.

2. To raise the same with more advantage then can bee done by any horse engine.

3. It is exposed to examination:

(1) Whether the same bee cheeper then the forceing Pumps, driven by water at London Bridge.

(2) or by the chain Pump driven by Horses and wind at Broaken wharf.

(3) or then by the New River from Ware to Islington.

(4) or by the Great Engine lately made by a Leigois for the French King.

(5) or by Sir Robert Howard's engine neer Epsom.[1]

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[1] Sir Robert Howard (1626-1698), dramatist and politician. He built Ashtead House, Surrey, in 1684.

(6) or the great engine at Tolledo in Spaine.
(7) or Sir Samuell Moreland's engine at Windsor.[1]

(*Endorsed.* "A Proposall for raising of water to any quantity or hight assigned.")

No. 120

Raising Water 1686

1. By a common Pump a man can raise 32 gallons 30 [feet] high in a minute, or 8 tons in an hour.

2. A frame which costs 45£ (of 30*s.* per foot) will serve for 20 pumps, vizt: 50*s.*[2] per pump.

3. The 20 Pumps will cost 50*s.* each or 45£.[3]

4. The omitted and contingent charges £10 more—in all £100.

5. The said 20 pumps will exercise 40 men, each working 12 hours per diem, at 12 pence per diem.

6. The interest and ware and tare of the 100£ above mentioned is £20 per annum; viz: 20*s.* for each pump per annum.

The wages of 40 pumpers for one year will be 730£[4] and the ware and tare 20£—in all 750£ per annum.

7. The said 20 pumps with 20 men at double hand, each raising 8 tons per hour will raise 3840 tons per day, and serve for 7680 families,[5] at the expence 2 hundredweight (?) of water per diem, or 30 gallons per head.

8. But if the water bee raised 60 feet, the said pumps will then serve but for 3840 families at 750£ per annum, or 15000 sh. So as a family is supposed at under 4*s.* per annum; besides the charge of laying pipes from the engine to the house.

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[1] Sir Samuel Morland (1625-1695), inventor. By means of a 'plunger pump' he had in 1675 succeeded in raising water to the top of Windsor Castle.

[2] ? 45 shillings.

[3] ? £50.

[4] *I.e.*, 40 × 12 pence × 365, no intermission being reckoned.

[5] Reckoning 5 persons to a family.

9. The charge of such pipes seemes to [be] 40*s*. per house. The interest and ware and tare whereof is 8*s*.—In all 12*s*. If the fine bee 20*s*. and the rent 20*s*., the same will bee 12 sh. per annum.

10. A like stage may be made for 2 pumps of $\frac{3}{4}$ feet, for 4 of $\frac{4}{6}$ feet, for 6 of $\frac{6}{6}$ feet, for 8 of $\frac{6}{8}$ feet.

11. It seems very convenient that every gentleman's house should have a well of 6 feet square, as deep as the ground requires, and that over the same be built a water tower higher than any part of the housing.

12. This tower should stand but at such a distance from the maine housing as to shoot water upon it in case of fire, and also in the middle of such garden grounds as need to be waterd.

13. So as this tower will serve (1) to force that water into every roome of the house, (2) to quench fire, (3) to water gardens, (4) to make waters of pleasure, (5) and to be an observatory of the stars and meteors, (6) to furnish waters to the neighbours, (7) for bathing, (8) for fresh experiments, (9) for drayning, (10) for clocks and dyalls of all sorts.

Conclusion

That by 4 paire of pumps, any house by one pumper, at per annum 20*s*. to 30£ (per diem) charge, may bee furnished per annum with 20 to 30 tons of water raised 30 yards [? feet] high per diem.[1] Wherewith to dresse meate, wash linnen, turn 4 turn-spits, water horses, cleanse the house, water gardens, make water works of pleasure, and quench fires.

This apparatus may cost 30£, or from 40 sh. to 30 sh. per annum.

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[1] This calculation is obscure. It would seem to mean that one pumper working 12 hours a day for four houses would raise 24 tons of water for each house. The cost for the four houses would on the figures given above work out at: one pumper 12*d*. a day, £18 5*s*. per annum; interest, etc., on cost of 4 pumps, £4 per annum: Total, £22 5*s*. per annum.

XX

SWEETENING SEA WATER

(121) Of Sweetening Sea Water—(122) About the making of Sea Water Fresh—(123) Concerning the Sweetening of Sea Water.

SWEETENING SEA WATER

IN the year 1684 there was published a tract with the following title: "*Salt Water Sweetned* or a true account of the great advantages of this new invention both by sea and by land: together with a full and satisfactory answer to all apparent difficulties. Also the approbation of the Colledge of Physicians. Likewise a letter to the Honourable Robert Boyle to a friend upon the same subject. By (R) Fitzgerald" (4to. John Harefinch. London, 1684).

Fitzgerald seems to have been soon afterwards granted a patent for his invention, and Southwell no doubt contemplated an investment in this enterprise, for we find him inviting Petty's opinion thereon (*Corr.*, 7th December 1685). Petty's 'Observations' were duly sent by return of post, together with some 'epigrams & mottos' on the subject, all of which were warmly acclaimed by his correspondent (*ibid.*, 23rd December). Some of the 'Observations' are here given, but I have forborne to print the bad English and worse Latin verses with which they were accompanied ("*Epigramma in machinam dulcificam*" and "*Cogitata Varia de machinae maris dulcificae*" Petty MSS).

No. 121

OF SWEETNING SEA WATER

1. I see no reason why distilled water should not be equall to any other water. Many physicians have certifyed the same, and many ships have certified their experience upon long voyages to the purpose.

2. It is averd by the Patentees that 100 gallons of water, weighing 800 ℔, may bee made in 24 hours with 3 pecks of sea coale weighing 50 ℔, by engines in bulk and weight under 600 ℔. and under £20 cost; and that the expence in coales, ingredients, and labor will bee under $3\frac{1}{8}$ shillings or $1\frac{1}{2}$ farthing the gallon.

3. The Patentees require but 3 pence per tunn per annum from the ship which use this engine.

Upon this state wee say:

1. That it will bee of vast advantages in beseiged townes where there is no naturall good water.
2. In all voyages to Africa, Asia, and America.
3. For Men of War, home trade and land carriage I doubt of profit to the patentees.

No. 122

About the Makeing Sea Water Fresh

1. Let there bee made a table for makeing in 24 hours 10, 20, 30 to 100 gallons, containing the weight, measure, and price of the engine for doing the same, as to each of the respective quantities, with the weight and cost of the ingredients; as also the weight and cost of the fuell for doeing the same.

2. Let it bee declared at how many days after distillation the said water is best, and most gratefull to bee drunk.

3. What seasible difference there is between the fresh waters made out of 10 severall seas, the most distant and different; as also out of the fresh water, as rain, rivers &c.

Although (as to the uses at sea) the principle qualities of the said sweetned waters is for quenching of thirst, and for making broath or porrige of flesh meats, pease, oatmeale, coffee and chocolate, and the infusion and decoctions of tea, and other ingredients for food and physic on board ships.—Nevertheless tis fit to ask the following questions, vizt:

(1) Whether fishes and other small animalls will live in these sweetened waters, as well as in Fountain, River, Pond, or Rain water.

(2) Whether vigitables as mint, balsam &c. will grow as well in the said sweetned waters, as in the other waters afore mentioned.

(3) Whether the said sweetned waters will keep as long from stinking and putrefaction, as any of the other waters above mentioned.

(4) Whether other waters upon distillation will not have more earth, salts, and other filth, than these sweetned waters will upon a second distillation; and whether the one bee not more light and cavernus (?) than the other.

(5) What difference there may bee found in tempering of meale for bread.

(6) In receiving the strength of corne, for Beer and Ale.

(7) In receiving of tinctures for dying.

(8) In makeing of hatts and dressing of leather.

(9) In making of sirups for Potecary's use.

(10) In hardning and refining of mettalls.

(11) For disolveing of sugar and other salts.

(12) For cheaper washing, and less soap.

Now supposeing the said sweetned waters to answer all necessary uses at sea; the next questions are concerning the proffit which may arrise out of the same to the Patentees, against which there may be made the following objections:

1. That the Ingredients are but pretences and of little use, and that the stresse lyes upon bare distillation.

2. The distillation of water, milk and other things is no new invention, and therefore cant bee brought under a Patent.

3. That small additions and alterations may allude to the Pattern,[1] and the jurys will bee able to find against the Patentees in such cases.

4. That no ship will go to sea under the experience of 2 or 3 voyages of these new sweetned waters,

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[1] *Sic*, but apparently a copyist's mistake for *Elude the Patent.*

during which time the engines, ingredients, and fuill for the said new practis will bee a sur-charge to the ship that uses them.

5. That it will bee many years expence to the Patentees without proffit. The invention, lyes, cavill, and ridicule and suspicion.

6. That foraigners will have formally the benefit of this invention, much more then the subjects of England where it was brought forth.

Notwithstanding, the advantages of this sweetned water for the uses of the sea, and other places where onely brakish water can be had, are these: vizt:

It will bee a great benefit to bee rid of the fraight and charge of cask for water in long voyages, and from the inconveniencys to go ashoare with men and boats to fetch water, and to deviat from their direct course in . . .

[*The end of this paper is missing.*]

No. 123

Concerning the Sweetning of Sea Water

(i) Concerning the goodness of them for quenching of drouth, and kitchin uses.

(1) Take the opinions and experience of practicall Physicians, Apothecarys and Distillers.

(2) Let experiment bee made for quenching of drouth upon 4 or 5 severall Persons, who are to drink 3 days of the distilled sea-water, and the like time of River, Fountain, or Raine water.

(3) As to the wholesomeness of the said waters: Let in the same ship 5 men drink of the distiled waters, and 5 others of the old ordinary provision; and let it bee observd, whether any two of those which drink the distild water, fall sick of the same symptomes,

before those who drink the old waters do complaine.

(4) Let the like experiments bee made in 3 or 4 other ships, upon severall voyages.

(ii) Concerning the Proffit of useing the said distilled or freshned sea-water at sea, supposeing the same bee found good as aforesaid for drinking and kitchin uses.

(1) It is a great Comfort through the Hott Countrys between the Canarys and the Cape, to have plenty of refreshing wholesome water to drink, and to bee sure of water upon all extraordinary disasters and disappointments. And it is likely that all seamen who are thoroughly satisfyed thereof, may serve for somewhat lesse wages then where such advantages are wanting; at least by so much, as will make up the premium given to the Patentees.

(iii) Whether the use of the said waters will bee proffitable to the masters and owners of shipping. For answer whereof, consider as followeth:

(1) The Bulk and weight of the distilling engines, recipience, and Repositorys, with the fuill and Ingredients necessary for the said opperation.

(2) The Charge and Cost of the said Engine, with the Intrest thereof per annum; as also the weare and teare of the same per annum, and the Insurance of that value, according their respective voyage.

(3) Consider the expence in Fuill, Ingredients, and Labor of working the said engine 24 howers, or by the Gallen or other measure of the water sweetned.

(4) On the other hand, consider the Cost of the Cask to carry Common-water, the fraight of the said Cask and water, and the Charge of fetching the same on board; with distinction when the said water is part of the said ship's burden, or part of her Ballast.

In order to the further answering of this question, wee put the following case, vizt: A ship of 100 tunn, where the Bulk and weight of the distilling utensills, together with the water requisit for cooling the worme, do weigh 800 neat pounds; the Cost of the engine with the Intrest of the said weight, with the weare and teare of and Insurance of the engine, to bee 40*s*. per annum, and the Charge of fuill, Ingredients, and Labor, & for makeing 20 gallons of fresh water, to bee 4*d*. Wee suppose the said ship of 100 tunns, employable upon 5 sorts of voyages; vizt:

1. The first, where 8 men will saile the said ship, where shee may make six voyages forth and back per annum, and consequently bee under saile about 40 days in the whole yeare, and where the fraight, is under 13*s*. 4*d*. per tunn; and such voyages is Coasting about great Brittaine and Ireland, and crossing from one to t'other, or crossing from Great Brittaine to the mouth of the Elbe eastwards and Merlaux[1] in France westwards, or any place between the mouth of the Elbe and Merleux. In which voyages water is not drunk, but onely used for dressing of victualls.
2. Of the Europe voyages: A second sort of employment for the said ship is in the rest of Europe. The points (?) whereof are the port of Archangell, Riga in the bottom of the Baltic, and Constantinople. In sayling to all which places, being along the Coast, fresh water may bee had for the labor and stay of fetching it on board, which the engine may save.
3. Of Voyages to the Canaries and Westerne Islands.
4. Of Voyages to Guinny and America.
5. Of Voyages from Africa into America with Negros &c.
6. Of Voyages to the Cape, Streights of Magellan, and forward to the Indies and South Seas.

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[1] Morlaix.

XXI

THE PACING SADDLE

(124) Of Calashes—(125) Advantages of W.P.'s Chariot.

THE PACING SADDLE

THE Calash, a prototype of the eighteenth-century Hansom, was introduced into England soon after the Restoration. It was a two-wheeled conveyance intended only for promenades in towns or for short distances. Petty early conceived the idea of adapting it to posting uses. He began to model a vehicle for this purpose in 1676 and called it the 'Pacing Saddle'—'as a name that will best please those that smile at Inventions' (*Corr.*, 13th January 1677). He was prepared, he says, to travel in it from Holyhead to London in three days without setting foot to the ground. Soon afterwards he sends Southwell a description of this 'engine,' which he explains "is designed to carry an unweildy, infirm & blindish Carcass over the Rocks & Bogs of Kerry, by night or day, in all weathers & ways, through fair & Christian Countries, not excluding Penmanmore in Wales." In March 1678 he informs his friend that he is about to set out in it on a 'three weeks progress.'

Perhaps this trial was not altogether satisfactory, for we find no further allusions to the chariot until April 1684, when Petty sends Sir John Werden a 'scheme of enquiries' and a note of the 'principal experiments' he had made in relation thereto. But in August of the same year he informs Southwell that 'the Chariot is done, so as I verily believe it can never be much improved.' The model appears to have been sent over to England soon afterwards. Meanwhile the 'Sluice Boat' had once more come upon the scene, and for the time being absorbed all Petty's energies. It was not till after the fourth and final failure of his 'Double bottom' that Petty followed his chariot to England.

The papers here given are dated soon after his return. Petty's invention must be reconstituted from them as best it may, for unfortunately no drawing or model of his posting chariot has survived.

No. 124

Of Calashes, 3 Aug. 1686

A Calash weighing 440 ℔. nett, to go by one horse of 15£ price, or with 2 or 3 men, with $\frac{1}{3}$ of a chairman's paynes & burden. Upon 2 wheeles or upon 4. To carry 1, 2, 3 or 4 persons with necessaries for a Journey: viz: 2 gentlemen with coachman and footman, as easily as one horse caryes 183 net ℔s upon his back, or 13 stone. The Calash to cost 15£ well adorned. The Coachman & footman hang upon the braces, as well as the gentlemen. If it go upon 2 wheeles, to poize the burden. Capable of Clignets,[1] Emproved against overturning & [will] turne better than with a Crowe's neck. As free from wind, rayne, dust & sun as one pleases. One horse caryes a Rider & Driver as easily as 120 ℔. net upon his back. To passe rocks & precipices & crooked wayes.

By one horse

(calash) 1 man	440 180	520 ℔.	whereof $\frac{1}{6}$ = 86 ℔ nett or 6 stone
2 men	440 320	760	whereof $\frac{1}{6}$ = 126 ℔ or 9 stone
3 men	440 500	940	whereof $\frac{1}{6}$ = 156 ℔ or 11 stone
4 men	440 660	1100	whereof $\frac{1}{6}$ = 183 ℔ or 13 stone

By 2 men

1 Rider	280 180	460	whereof $\frac{1}{12}$ = 38 ℔
2 Riders	280 320	600	whereof $\frac{1}{12}$ = 50 ℔.

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[1] ? 'Clighting,' an obsolete word meaning bending or twisting.

Memorandum: That one horse of 15£ & Calash of 15£, with a Coachman & footman, will cost 100£ per annum.

Memorandum: That this Chayse may bee also carryd as a sedan without any wheeles.

No. 125

Advantages of W.P.'s Chariot made 6 Aug. 1686

1. It caryes 3 Riders with one horse, more easily (by $\frac{1}{8}$ part) then a comon coach doth 6 with 2 horses.
2. This may in craggy crooked wayes bee driven upon 2 wheeles onely, and by two men without any horse for a little way.
3. In this, without any horse at all, 2 men can carry one, at $\frac{1}{3}$ of a chayreman's labor, up and downe the streets of London.
4. This may be used as a sedan.
5. All the riders (even coachman and footmen) hang upon braces like the body of a comon coach.
6. The charge hereof with reparations, as also of an horse, coachman and footman, will be under 100£ per annum.
7. It will bee quickly and easily made redy upon call, and lyable to lesse damage upon attendances.

(*Endorsed.* "The advantages of W.P. his single chariot 1686—not $\frac{1}{3}$ the price of a comon chariott.")

XXII

MEDICAL

(126) History of the Magdalen—(127) Scheme for a Medical essay—(128) Via brevis ad medicinam—(129) Anatomy Lecture—(130) Epulae—(131) Optical.

MEDICAL

DURING the Civil War Petty had studied medicine at Utrecht, Leyden, Amsterdam, and Paris. After returning to England in 1646 he became successively Doctor of Physic, member of the Royal College of Physicians of London, and Fellow of Brasenose College, Oxford. It was in that city in 1650 that he acquired fame by restoring to life one Anne Greene, who had been executed—as it seemed at the time successfully—for child-murder.

The story of this exploit was printed at the time in the *Phoenix Brittanicus* (i, 233). It was no doubt supplied by Petty, for though not identical with, it differs in no material particular from his own account as given below (No. 126). Owing perhaps to the *réclame* of Anne Greene's revival Petty was made, in 1651, Vice-Principal of his college and Oxford Professor of Anatomy, which posts he exchanged in the following year for that of Physician to Cromwell's army in Ireland.

His practice, as he tells us in his will (Fitzmaurice, 319), was at that time worth nearly £400 a year, while in a letter to Southwell he says that if he had returned to England (as he might have done after the completion of the Down Survey) in 1656, he would have been 'at the top of practice in Oliver's Court; when Dr. Willis was casting waters at Abingdon Market & "the Cock" Lower was but an egg' (*Corr.*, 13th July 1686), but his activities were thenceforward otherwise directed.

Petty's MSS. contain a quantity of medical notes and studies, for the most part written in Latin. Amongst them are several of the works, hitherto assumed to be lost, which are mentioned in his list of 1671 (No. 158 *infra*).

The second paper (No. 127) printed below (of which the heading is my own) appears to contain the scheme for some of these essays. Petty first gives the subjects about which he is going to write, and then lays down the rules by which he proposes to be guided in dealing with them. The initial notes seem to foreshadow the papers mentioned in his list of

1671 under the titles *Pharmacopoea et formula medicamentorum, Observationes Medicae et Praxis, De Plantis,* and *Notae in Hippocratem,* while he speaks (as in the Epistle Dedicatory to the London Bills of Mortality) of collecting 'luciferous experiments' for the illustration of his work.

I have, however, printed this fragment rather for the sake of what follows. For the latter part of it explains Petty's theory and method of deductive investigation, or 'ratiocination' as he himself preferred to call it. In this case it was to be applied to medical phenomena, but *mutatis mutandis* the method was the same as that which he afterwards developed in the economic sphere and called 'Political Arithmetic.'

No. 128, *Concerning the study of the art of medicine,* is endorsed, *Via brevis ad medicinam.* This was one of Petty's 'tractatiuncli' specially mentioned by Aubrey (Introduction, xix), and was no doubt written much later than the preceding paper. It is specially interesting in its recommendation of Comparative Anatomy which was at this time scarcely practised except in Italy, and in its suggestion of a general essay on occupational diseases.

No. 129 is merely headed "Anatomy Lecture." From its context we can see that it was delivered in Dublin to the College of Physicians, which had been instituted there by Letters Patent, in the year 1667. John Stern or Stearne—according to his epitaph in Trinity College "Philosophus, Medicus, summusque Theologus idem"—was its founder and first president, and Petty was one of the original governing body of fourteen fellows who controlled its destinies. It seems to have fallen to his lot as the senior fellow to address the 'College' on the occasion in question.

The date (*c.* 1676) is supplied by Petty's claim that he is taking up his subject 'after four & twenty years discontinuance,' for we know that he had given up medicine and the Anatomy professorship of Oxford in the year 1652. The paper is clearly unfinished, and as evidently dictated to someone whose knowledge of orthography in general, and of medical orthography in particular, was of a limited nature. In the original, 'anatomy' is invariably given as if it were two separate words—'a natomy'! Petty himself explains his difficulties, in having to 'see with other mens eyes & to work with borrowed hands' at the time when this lecture was delivered.

From certain allusions to this 'discourse' in the *Correspondence* it may be seen that the ideas to which it gave rise were afterwards developed by Petty in the much discussed (but never completed) essay on the *Scale of Creatures* (*supra*, No. 87).

No. 130 is a mysterious document, with no explanation other than its heading—" Epulae ad ♀." It bears the form of a medical prescription, hastily scrawled and almost illegible, but from its ingredients (all of which appear to be in the nature of 'aphrodisiacs') it may be supposed to have been set down in jest for some ribald friend.

Petty was introduced to the science of Optics by Hobbes. Aubrey tells us that: " At Paris . . . he read with Mr. Thomas Hobbes who loved his company. Mr. H. then wrote his Optiques. Sir W.P. then had a fine hand in drawing and limning and drew Mr. Hobbes opticall schemes for him, which he was pleased to like." This must have been before 1644, for Hobbes' *Tractatus Opticus* was published by Mersen in that year. The headings in *Opticall* (No. 131) appear to have been drawn up either for a course of study in that science or for a discourse before the Royal Society. Petty's defective vision, which I have already noticed, no doubt caused him to take a peculiar interest in this subject.

No. 126

History of the Magdalen
(or The Raising of Anne Greene)

Upon the 14th day of December 1650, there was brought to the place of execution, one Anne, daughter of Wm. Greene of Steeple Barton in Oxfordshire, for having as was alledged murthered her owne new-borne infant, and there hung by the neck above ¼ of an hower. And while shee was hanging, divers friends of hers and standers by, some hung with their whole weight upon her, others gave her great stroakes on the breasts; and moreover a souldier did the same severall tymes with the butt end of his musquett. When she was cutt downe and putt into the coffin (which was sent for her by those to whom her body was consigned to bee dissected) and brought to the place where the said dissection was to bee made, and the coffin opened, she rattled in the throate; Whereupon a lusty fellow standing by stampt upon her breast and stomach severall tymes with his foot.

Presently after myselfe and Mr. Willis[1] came in, and found her yett to rattle a little as before, notwithstanding the said latter stroakes. Whereupon, she yett lying all along in her coffin in a cold roome, wee wrenched open her teeth which were fast sett, and putt in some strong waters. Whereupon shee seemeth obscurely to cough or spitt. Wee then wrenched open her hands, the fingers being also stiffely bent downe, and fell a rubbing her extreeme parts. While wee continued thus doing for a quarter of an hower, and while a fire was making, wee thought of letting her blood. As soon as her arme was bound for that purpose, shee suddenly bent it, as if it had been contracted by a convulsion fitt. The vayne beeing cut, shee bled so freely that having bled about 5 ounces, when we desired to stop, wee could not easily.

All that while her pulse was very low, but otherwise not much amisse. When her arme was bound up, and [she had] ever now and then taken a little of the strong waters, and the fire was kindled, wee kept rubbing her in severall places, tickled her throate with a feather, and bound her thighes; afterwards gott her putt in to a bed very well heated. Then wee ordered her a more temperate and cordiall water to take, than the hott spiritts wee used before in our hast, viz:

℞[2] *Aquarum Cœlestis*[3] (*et*) *Cinamomi* *āā*[4] ℥*j*[5] *Lujulae*[6] ℥*iiij.*

---

[1] Thomas Willis, M.D. (1621-1675), a popular physician who afterwards obtained an extensive practice: not (as stated in Fitzmaurice, 19), Dr. Wilkins, principal of Wadham.

[2] Recipe, 'take thou.'

[3] Rain water.

[4] *Partes aequales.*

[5] One ounce.

[6] *Lujula*—better known as *Acetosella*—is a preparation of sorrel.

Then wee anointed her neck, where the roape had passed, with spiritt of turpentine. Then finding her feete extreame cold, wee caused them also to bee anointed with the said spiritt and well rubbed, perceyving that as her sides or bottomes of the feete hapned to bee touched, that shee moved her lower parts. Wee then orderd:

> ℞ *Olei Maiis per expressione* ʒ*j* [1], *olei Caryophyllei per distillatione guttarum iiij* ♏.[2]

with this wee anointed her nose in the inside and temples. Wee applyed upon her breasts *Emplastrum stomachicum majistrale.* Wee ordered the following healing and odoriferous clyster [3]

> ℞ *Brodii* [4] *carnis versecinae vel posseti* (*cui incoxerint folia Majorani, Lauri, Origani, Rosmarini* āā ♏ *ſs;* [5] *Bauenlauri,* [6] *Juniperi semina, Anisi, Fœniculi* āā ʒ *ij*) ℥*x, olei Camaelii, Anethini saccharati rubei* āā ℥*j, olei Spicae* ʒ*ij* : *Duabus vicibus.*

Having taken these generall things wee persuaded a woman to goe into bed with her, and to keep rubbing her lower parts gently. Upon all which shee seemed about noone to bee in a sweate; her face also began somewhat to swell, and to be very red on the right side, on which shee had been lett blood. All this while she scarce opened her eyes, and if shee did, suddenly shutt them againe. We called to her to know whether she could either speake or heare, but wee found shee could neither. All this while she breathed handsomely, her pulse equall but low. Some part of her clyster came away about an hour after it was given, about 3 in the afternoone. Wee used a candle end by way of a suppository, which brought away somewhat more thereof.

About this time we tried againe her senses, bidding

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[1] Dram.

[2] Minim.

[3] An injection or enema.

[4] *Brodium*, broth.

[5] *Semissis*, 'a half.'

[6] *Bauenlaurus*, the bay tree.

[her] move her hand or open her eyes; Whereupon she obscurely opened her eyes. Now and then shee coughed pretty cleerely and strongly. About 4 of the clok, fearing her face might swell more, and the fever come upon her, wee bled her (about 9 ounces) in the right arme again and ordered her a julep:[1]

> ℞ *Aquae Scabiosi, Lujulae āā ℥iij, syrupi Tussilaginis, Violarum, Limoniorum āā ℥ſs confectio Alkermidis*[2] *ʒj: Aqua cordialis prius praesumpta. ℥jſs, capiat cochleae tertia quaque hora.*

We ordered her also *Aqua Hordei* ♓[3] *i ſs cui incoxerit Tamarindae ℥iſs. addita syrupus Violarum ℥j pro potu ordinario quotidiem sitiverit.*

About this time shee eate a few spoonefulls of thin Caudle, beeing putt in to her mouth, and was able to swallow it.

We also caused a suppository of allum to bee putt up about 9 at night, which brought away somewhat. Then we left her, whom company had perpetually thrust in upon, in the small close roome where shee lay continually from 9 in the morning to that tyme. About 2 howres after, shee began to speake many words intelligibly.

In the morning about 8 wee found her much amended, and able to answer to any question wee propounded unto her. Her blood let out yesterday, was very good, uniforme, and fibrous. She then complayned of her throate, but not much of any other part. Wee then appointed for her throate a cataplasme[4]:

> ℞ *Summitates Malvae foliarum, Alsinis, Plantaginis āā ♏ j, radix Altheae viridis ♏ ſs, pulpae panis ℥iij. Coquitur in lacte recentiori quod sit in fumam* (?) *delitam* (?). *Addito butyri . . . quod sit applicetur tepidus.*

---

[1] A sweet drink.

[2] A preparation of the plant Alkermes.

[3] Pint.

[4] Poultice.

Shee now complayned of drought and asked for small beere. Wee offered the barley julep, which she tooke with difficulty, and at last refused. Wee then gave her small beere warmed, but shee neither relished that also, saying something else was in it. We then gave her some cold, which shee dranke and liked, thanking us.

All this while shee [was] laying, sighing often, and when she spake, talked, as shee certainly did in prison before her execution, of being patient and contented with her sufferings &c. About noone shee felt her breasts and sides extreame soare. We looked upon them as wee had done before, but saw nothing black and blew, or like a contussion. She was very fatt and fleshy, of an high sanguine complexion, but had not slept nor eaten much for 3 or 4 days before this tyme. Wee then ordered a clyster and cataplasme for night, viz:

> *Decoctio communis per clystere ♓j, Cassiae electuariae lenitivae, Sacchari rubei āā ℥j, Salis communis ʒj. The Cataplasm,* ℞ *Cataplasma prius praescriptum quod sit ad conti*[*n*]*gendum partus.*

The clyster, by the women's unhandiness, was scarce halfe putt up. The Cataplasme applied, and a Rosicate, wett in rosewater and vinegar applied to her temples; and so [she] was left to rest between 8 and 9. About this tyme she talked merrily and laughed severall tymes, and looked very fresh and of a good coulour; in little fever, her tongue not furred or clammy.

Monday the 16*th ditto*—Wee came to her againe, found her to have taken some rest that night—her feevor not much encreased. A little complayning of drought, but finding relish in her small beere. (She made some water this night, but had no stoole.) She eate halfe or ¼ of [a] pint of panada,[1] and liked it well. Wee let her blood, 5 ounces more, in the left arme; shee fainted not, complaynd somewhat of her head and stomach and throate, raised up herself to bee lett blood, talked very sensibly and heartily. (About 11 this day shee had an easy stoole, somewhat loose; eate severall tymes of her panada and *cremor hordei*[1] by little and little.) Before wee lett her blood (having putt all the company out of the roome, saving myselfe and 3 men of our faculty) wee asked what she could remember of all that had been done to her. Shee answered that, since shee had putt off her bodies [bodice] which cost her 5*s*., and given [it] with one of her coates to her Mother, which was betimes in the morning, and that she had heard some say that old Townesend was gett[ing . . . a . . . c[2]]hayne to putt her to death, shee remembred nothing at all; neither how shee came out of the prison, wa[lked] up the ladder &c, nor what shee had spoken on the s[caffold]; although shee had spoken sensibly enough there. Another thing is observable, that her first speeches after shee came to herselfe, were much like those shee had used immediately before her execution, with often sighes, &c.; as if there had been merely a cessation of her life and that shee had just gone on where shee left of before.

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[1] Bread softened in water.

This day at night she was fomented about the sides and other contused places. Her neck was soare, especially on the left side; being all black and beginning to blister. There were divers spots of settled blood on her right cheeke also.

Tuesday the 17th in the morning, we found her pulse slow but unequell. Her courses had come down fresh this morning. Her tongue not very dry, nor rough. Had slept reasonable well. (When she rose to have her bed made, her head was light, that she could hardly stand up right. She complayneth of paine beneath the pitt of her stomach. She complayneth also of a deadness in the extremity of her tongue, thinking she had bitten it in her suffering) We prescribed her:

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[1] *I.e.*, barley water.

[2] Part of the document has perished at this point.

℞ *Radix Rubiae, Mumiae,*[1] *Lapis hybernici,*[2] *Rhubarbae āā ʒj, Spermaceti ʒij, Castorei ♏ ſs. Fiat pulvis melle despumato excipiendo. Hujus electuarii capiat circiter ʒj ſs bis in die, superbibendo haustula postulata.*

℞ *Unguentum dialtheae ℥ij, olei Lilliarum albarum ℥j ſs. Fiat linimentum regioni pectoris post fomentationem illinendum.*

℞ *Unguentum Rosaceum ℥j pro cervice.*

At night we saw her againe. She endeavoured to make water [but] could not. Shee calld this day for some bread and could eate it soaked well in beere. The paine of her neck and throate decreased, the deadness of her tongue remayning. The spotts of settled blood upon her cheekes lessened, as also that about her neck.

18*th*—She slept 6 or 7 houres this night. In the morning had no feavor, her pulse much mended, all symptomes lessened. The paine of her breast seemed to descend into the region of her belly, beeing as we conceyve in the muscles. She continues her ointments and electuery[3] twice per diem. She had more of her courses.

19*th*. Shee was up. Eate the leg and wing of a chick; all symptomes decreased. Cannot go without holding a table or the like. Her neck still soare, but mending. The deadness of her tongue lessened.

20*th*. Slept well, had a small stoole, made enough of reasonable good urine. Symptomes still lessening.

About 4 or 5 days after there appeared (in a hard frosty weather) a blacknes all over the lower part of her arms and in her flanks on the same side; which afterwards vanished away within 4 or 5 days, by degrees becoming yellow.

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[1] Ground up mummy, [2] A form of slate, both much used as drugs at this time.

[3] A sweet medicine.

Anne Greene's Petition[1]

The [petition] sheweth:

That your distressed Petitioner, not having the feare of God before her eyes, was led by the often temptations of one Mr. Jeffrey Read, grandchild to Sir Thomas Read of Dunstew[2] in the county of Oxon, into the foule and fearefull sin of fornication, and thereupon became with child. And about the 18th weeke miscarryed thereof, in such a manner as your Petitioner could not make knowne her delivery of her said conception as shee desired, and as the law of the land requireth. Whereupon she was condemned to dye, and withall was deprived of any benefitt of law against the said Mr. Read. And accordingly your poore Petitioner hath suffered more in order to her death than ordinarily, with many other sad calamityes. But notwithstanding, by the extraordinary and miraculous blessing of God upon the endeavours of some Physicians that came when shee lay in her coffin with an intention to anatomize her, she is now in a manner recovered, and also by the Justices (acknowledging this great act of Providence) reprieved.

Your poore Petitioner humbly beseecheth the . . . to consider her great and undeserved sufferings; and as God hath miraculously owned her preservation, so that the honourable . . . could not oppose the same Divine Providence therein, but grant unto her a pardon from the sentence passed upon her, and some recompense from the said Mr. Read, the occasion of this her misery; your poore Petitioner not having deserved (?) the law, which shee hath patiently endured, as may appear by the certificates annexed.

And your Petitioner shall pray &c.

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[1] Query: to the Privy Council. The document (like the preceding) is in Petty's hand, and much cut about.

[2] Sir Thomas Reade of Dunstew (d. 1650) married the heiress of Brocket Hall, where the family resided for several generations.

[The "Certificates"]

Wee the Physicians (whose endeavours God having most wonderfully blessed in the reviving of Anne Greene, and in the curing of the suffocation, contusions, and other accidents arising from her execution), thinking it our duty (so farre as lawfully we may) to bee also instrumentall in preserving the life of the said woman from any further execution of the sentence passed upon her, have taken the humble boldnes to tender our Reasons to whomsoever it may concerne. That the child (whereof the said Anne Greene was delivered, and for the supposed murther whereof shee was condemned and put to death) was not onely abortive or stilborne, but also so imperfect, that it is impossible it should have beene otherwise. And also that as it is very probable, that as shee did not procure the death of the said child, so that shee might not at that tyme certainly know shee was with child, or that she had beene delivered thereof. Whereby wee humbly conceive her in a great measure excusable in not making her said delivery knowne, as the law of the land in that behalfe requires.

As for the former, vizt: That the child was stilborne; wee alleage the midwife's owne testimony, who said that shee did not thinke it ever to have life, and that it had no hair. And other women do assert that it was little above a span long and the sex scarce distinguishable; yea, that the whole rather seemed a lump of flesh, than a mature and onely formed child. Besides, her fellow servants, who constantly lay with her, can witnesse that shee had certaine issues upon her for about a month before; which were of that nature (wee having well considered all the circumstances of them) that could not consist with the vitality of the said child. And it is moreover certainly knowne that, immediately before the eruption of the said issues, shee violently laboured about screening malt, which probably might [be] (and as shee herselfe constantly affirmeth was) the first cause of her said abortion.

[1] As for the latter, viz: that shee did not voluntarily cast it into the house of office on very purpose to conceale it, we are apt to believe; because if shee had, wee humbly conceyve that shee must have done it either to avoid the shame of having beene with child, or else to bee quit of the trouble and charge of keeping it. The former reason wee suppose not to have beene in her thought, because wee are informed that before her delivery, shee confessed that shee had done what might cause her to bee with child; and so, if the child had beene seene, the shame had not beene much greater. Not the latter; because shee would scarce be so ignorant as to feare a child, born at 4 monthes, could live and need the trouble and charge of maintenance. Now shee hath all along affirmed that her delivery was not [for] full 5 months after Mr. Read, the father thereof, first had the use of her body; and the bignes, and other aforementioned condition of the child, doe demonstrate that it had not beene longer conceyved.

Moreover to prove that a child of that tyme, may suddenly slip away, and not bee felt, and as in this case (the mother sitting on a house of office) may also not bee seene, we shall not alleage the many like cases recorded in authors, or fly to our owne observations long since or far postreme[2] made, but wee can produce the women yett living in Oxon. . . .[3]

* * * *

Wee also humbly desire to represent what wee know of her sufferings: viz: That suddenly upon her delivery she was carryed up and downe by severall Justices of Peace, and within 3 days brought to Oxford both on [a] very cold and rainy day, being exceedingly sick and weake. Passed about 3 weeks in a most comfortlesse place and company, sufferd continuall fright and terrors, and at last was hanged by the neck, full as long as is usual. Was often struck on the breast and stomach, while shee thus hanged; was lifted up severall tymes and jerked downe againe, thereby to have broken her neck, and lastly was three tymes dangerously stamped upon by her friends as she lay in her coffin, who thought thereby to have despatched her out of the small and miserable remnants of life that then first appeared.

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[1] The paragraph which follows is crossed through in the original, as if on second thoughts Petty had come to the conclusion that it would not strengthen the case for Anne Greene.

[2] ? afterwards.

[3] There is a gap in the document at this point, in which it was no doubt intended to cite instances of similar miscarriages amongst the women of Oxford.

These things, besides the deserved shame of her foule sin of fornication, she had already undergone with great patience and resolution; which the generality of good people (who came in great numbers to behold and admire this signall act of Providence) doe unanimously desire may be accepted for satisfaction in lieu of the sentence passed upon her by the law, which wee believe, rather the desires and good intentions of her Judges to discover and punish wickedness, as also their excusable unacquaintance with the physicall part of these cases, have produced, than any cleere demonstrations of her guiltines of a crime deserving so severe a punishment.

No. 127

(Scheme for a Medical Essay)

The practise & Theory of pharmacy, & prescribing forms.

Hippocrates & Galen (especially the former) & the Greeke Tongue.

The practice of Consultations & speaking latine.

Some new Theory of physiology and pathology.

To collect luciferous experiments to that purpose. (Botanicks.)

* * * *

That as few as possible of insensible things, and such as cannot be examined by experiments, bee supposed.

That if there bee, their nature in all qualities may bee described in a sensible manner.

That nothing bee supposed impossible or absurd.

That the supposition bee simple & short, & easily intelligible.

That it solve all the phaenomena.

That from it nothing may follow but what appeares.

That as many such severall suppositions as possible may bee found out & the most suitable retayned.

That none of all the suppositions made upon divers matters may disagree and bee inconsistent one with another.

That having made suppositions of matters of many different natures, some principles bee afterwards drawne from them all, which were common to all the said suppositions and dispersed in them.

That we find out sensible effects which are produced of sensible and cleere causes, very like unto other sensible effects begott from insensible causes.

No. 128

CONCERNING THE STUDY OF THE ART OF MEDICINE

[*Via brevis ad medicinam*]

When a youth of good understanding and good sight, that can reade his mother tongue, comes to ten yeares old, let him learne to write and draw some arithmetic and grosse geometry, and the use of the globes; as also to understand the Lattine and French tongues.

(1) The knowledge of about 300 such plants as grow naturally in the county where he lives, and 100 such as are of most frequent use in Medicine, as also as many exotic drugs.

(2) Upon this for preparatories, let him learne (but not by bookes but *per autopsum*) the anatomy of Man, of a dog, of a cock and hen, a salmon, eele, lobster, and oyster.

(3) Let him learne to distill, sublime, calcine, crystalize.

(4) Let him learne to make syrups, oiles, lozenges, oyntments, plasters.

(5) Let him know all outward tumers, excrescences, defœdations of the skin.

(6) Laxations, fractures, cuts, stubs, bruises.

(7) Bandages, incisions, trepans, amputations, lithotomy, cauteries, phlebotomy, cupping, leeches.

(8) Observations upon the ends of the hayre, nayles, teeth, gums, lips, tongue, countenance, color, breath, eruptions, sweat, belly, scrotum, pulse, breathing, urine, blood, spitting, soil, sneezing, fæces, earewax, eye, voice, smell of the whole.

(9) Appetite, eating, sleeping, pains, and the periods.

Observations upon Physicians

Vizt:

(1) Whether [there be] fewer out of the members of the College of Physicians, then out of the like number of any other Society.

(2) Whether there bee more above 70 yeares old amongst them, then in the like number of any other Society.

(3) Whether they take as much medicine and remedies as the like number of men of other societyes.

(4) Whether of 1000 patients to the best physicians, aged of any decad, there do not dye as many as out [of] the inhabitants of places where there dwell no physicians.

(5) Whether of 100 sick of acute diseases who use Physicians, as many dye and [in] misery, as where no art is used, or only chance.

Let tryall be made:

Upon persons of sedentary trades; as taylers, shoemakers, glovers, buttonmakers.

Upon lead-smelters, plumers,[1] red lead and white lead makers, letter carders.

Upon husbandmen, shephards, huntsmen, foulers.

Upon sea-fishermen, saylors.

Upon fryers, who eate no flesh meates.

Upon Universitats [2] (?) &c. who use regular dietts.

Upon [some] of great drinkers of wine, tobaco, coffee, tea.

Upon Trumpeters.

Upon the dwellers in fens, marshes, Essex hundreds.

Upon the inhabitants of heaths, planes, downes, mountainous countryes.

What diseases and symptoms are discernible by the vulgar:

> Falling sicknes, Apoplexy, Lethargy, Astma, Atrophy, Flux, gonorhœa, dropsy, convulsions, smallpox, measles, bleding, gowt, stranguary, rupture, ague, spotted-feaver.

Observations upon

The severall months or quarters of the yeare.

Upon different yeares and their diseases.

Upon Endemic diseases.

Upon birthes, abortions and childbeds.

Upon the deaths within the severall decads of yeares.

Upon the ages of the whole parish as one man.

Upon the coming in and going out of diseases.

(*Endorsed.* "Via brevis ad medicinam.")

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[1] Plumbers.

[2] ? Dons.

No. 129

ANATOMY LECTURE

(Dublin, 1676)

It falls out very unhappily for this honorable assembly, for the University of the Colledge of Phisitians and myselfe, That I am the first of all that are now alive (namely in his Majesty's Letters Patent, whereby the Colledge of Physitians is Instituted in this Citty), and consequently that I am bound (Doctor Sterne being Dead) to breake the Ice in all matters and Dutyes that this Society shall think fitt to promote. And it falls out as unhappily that this subject of Anatomy, and this proper season of the year, and their inclinations to begin their Exercise, should all fall out and fall upon me at a time when for many reasons I am most unfit to engage upon them. But how can a man express his Love and Duty better towards any person or thing then to ventur hard for its sake? Wherefore I do vindicate myselfe from not honoring the faculty of medicine, and [I speak] out of a desire to begin a plantation in Ireland of a plant which never yet did much flourish here, and to draw of the studyes of this nation from fabilous uncertain and contentious learning to the contemplation of God's works; and amongst them of the fabrick of animals, and amongst the animals of man who bears the Image of God himselfe.

Upon this account do I, after fower & twenty years discontinuance, and when I am forced to see with borrowed eyes & to work by other men's hands, & when my mind is sophisticated with forreign thoughts, do I expose myselfe to the censures of the captious world from whom I use to find little favour, and indanger a crazy vessell upon a troubled sea in a stormy season.

Gentlemen, the work of this day is to open the way into the practice of Anatomy and into the knowledge of Man's body. In the first place, to excite men into the admiration of God its Creator; and in the next place to cure and ease the cares and distemper that befall it; and lastly to shew proud man that his most misterious and complicated engenry is nothing to the compounded & decompounded misteryes in the fabrick of man. That all their Statick, and Hydro-Statick, their Hydrolick and Trocholick, Theroptick & Skenoptick, the Recowsticks & Musick their pnematicks and Ballesticks, and all other their mechanicks whatsoever, are no more compared to the fabrick of an animall then putting to sticks a crost is to a loome, a clock, or a ship under sail—the latter whereof (supposeing her men to be animall sperits) coms nearest to an animall of any thing I know. I say these are the 3 ends which I propound for anatomy; altho no man can be a perfect painter or statuary without it, nor can any man take a better course to find out curious and usefull engins then by takeing the bodyes of animalls for his Piece and Pattern.[1]

But whether what I have said be sufficient or not to beget in this Audients a good opinion of this undertaking, let me ad that all the great Cittyes of Europe have their Colledge of Phisitians; and every Colledge hath its Theatre for Anatomy, and our Methropolise London is building the most August and Comodious Theatre that perhaps has ever been seen in Europe. And truly I take such a Theatre to be (without Metaphor) a Temple of God, and do hope ere long this great Citty will have such a Tabernacle for him. I say since it is the practice & policy of great Cittyes and States to sett forward and promote anatomy, and since his Majesty by his Letters Patents has instituted a Colledge of Phisitians, and since his Excellency the Lord Lieutenant hath afforded a Subject for our operations, I think it every member of this Societyes duty (and consequently of my own) to honor God, the King, and his Lieutenant in the improvement and application of their favour.

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[1] This paragraph is printed as written in the original, but needs some elucidation. By 'Trocholicks' Petty means the study of the mechanics of pulleys. 'Thermoptick' (*i.e.*, Thermometric) should probably be read for 'Theroptick,' and 'Scenoptick' (the science of perspective) for 'Skenoptick.' 'Recousticks,' if not a mistake for 'Acousticks,' might be Re-acoustics, meaning the study of echoes. 'Pnematicks' should be Pneumatics. 'Putting two sticks across' each other seems to be an illustration of the simplest possible form of an engine. The expression 'Animal spirits' is used in a technical sense, as opposed to 'Natural' and 'Vital' spirits. To take 'for his Piece and Pattern' means 'as his Masterpiece.'

Gentlemen, the through knowledge of the fabrick of animals is not to be attained from the publick and promiscuous Demonstrations from a Theatre, nor from any worthy [wordy?] and tumultory discourses that can be made about it; but from curious and minute Disections made *pirociam excellentiam* (?), from various insufflations of wind, injection of Liquors, Severall colours and consistansies, by various ligatures and transfugions, and by severall Desications, excarnations of membranes and *parenchimas*[1]; and not by looking upon things at a great distance and *in transitue*, but by poreing upon microscopes, upon small particles illuminated by extraordinary helps.

Wherefore I shall not abuse this audience by promiseing them the entire knowledge of animalls from anything I entend to say or do here. I hope it will be sufficient for this first attempt (which shall consist but of two Lectures) to make our general *operatus*, to expound how we intend to proceed, with the uses and reasons of it, and to premise some few prelimineryes relateing to the art of medicine in general and the practice of anatomy in particular.

Wherefore I say of medicine, that it is the most Godlike of all other Illustrious facultyes, and is that which our Saviour onely practiced while he was upon Earth. Hee discountinancd Ezickell in the worship of God, he explauded severall traditions and ceremonyes, taught reall pure and cencere Doctrines, he declared that his Kingdome was not in this World, he declined to divide inheritances between man & man, he paid tribute but exacted none, he overthrew the tables of the mony changers. But all this while hee cured the blind and the lame, he stoped issues of blood, restored paraliticks and rebuked feavors, and expelled evill spirits, and cured the most horid distempers riseing from the most occult causes; and to justify the faculty of medicine did descend to the pharmacy of makeing up a *Colyrium* from the mixture of Clay & Spittle, and his holy Apostles did Justify their mission to the world by following their Blessed Master's Example.

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[1] The *substance* of glands or other bodily organs.

I might here enquire into the causes of the contempt of the art of medicine, as other men have done concerning the Clergy. And the first reason I give for it is the neglect of anatomy, which was not at all cultivated till within this last 150 years. Wee have heard that Democrytus[1] did curiously inspect severall animalls; but his labours were so supprest that none of his anatomycall labours were transmitted to posterity, altho great Hippocrates did admire them. As for Gallin's[2] anatomy, how glorious a shew soever it has made in the world, it seemes to have been but a course desection of apes. Vesalious[3] of Brussels, who lived about Henry the 8th time, was the great instorator of those enquiryes. Since his time the Venae Lacky, the Circulation of the blood, the Capsulae atribulariae, Pequet's ductus thoraticus, Wirsung's ductus pancreaticus, and the valves within the veins, as also the limpheducts have been discovered;[4]

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[1] Democritus of Abdera, the Ionian philosopher.

[2] Galen of Pergamum (A.D. 130-200), the most fertile of the Greek anatomical authors.

[3] Andreas Vesalius (1514-1564), the restorer of anatomy.

[4] Dr. Charles Singer has explained this passage as follows: 'Venae Lacky' should read *Venae iliacae*, and 'Capsulae atribulariae' *Capsulae atrabilariae*, *i.e.*, what are now called the 'suprarenal bodies.' Jean Pecquet, who died of drink in 1674, was the discoverer of the *ductus thoracicus* or thoracic duct, while the *ductus pancreaticus*

besides the method of desecting the brains, the glandules, & testicules have been much emproved, and severall bowels have been vindicated from absurd uses. Milk has been found to be kile, and not blood blanched; the water swiming upon blood is now known to bee a neutrative, and not an excramentitious Juyce; the water within the womb of Impregnative females have been well proved not to be the sweat or the urine of the foetus; the use of ayr in respuration hath been better cleared; severall doctrines about generation have been rectifyed, and in briefe more has been done the last 150 yeares then was done in 3000 years before. So as the reall Art of Medicine cannot be older then Anatomy, which as I said before is very new; and I humbly conceive that if anatomy had been well encouraged for these last 150 years that a 150 times more then is might also have been done.

Another cause of defect in the art of medicine and consequently of its contempt is that there have not been Hospitalls for the accomodation of sick people, Rich as well as Poor, so instituted and fitted as to encourage all sick persons to resort unto them—Every sort of such hospitalls to differ only in splendor, but not at all in the Sufficiency for the means and remedy for the Patients health. For by such means the most able understandings might be encouraged, equally with the best of the professions, to spend and to dedicate themselves wholy to this faculty; and a man shall learn in a well regulated hospitall, where he may within halfe a hower's time observe his choice of 1000 patients, more in one yeare then in ten without it, even by reading the best Books that can be written. For, as one may learn to know and distinguish a face

(pancreatic duct) was named after George Wirsung of Augsburg who was murdered at Padua about 1643. Dr. Singer remarks that the whole of this paragraph is remarkable not only for the completeness of the knowledge that it exhibits, but also for the judicious character of the judgments on physiological principles involved, all of which were then in dispute.

better by one minut's Inspection then by reading ten sheets of paper in the description of it, So wee may learn more of sick people by the Joynt assistance of all our sences together then by the lame descriptions of words alone.

A Third Reason is because Phisitians are not qualifyed as Divines, Lawers, and Soldiers are. For all those are Instruments of Government and are paid by the State; and the People must have such divines, Armyes, and Administrators of Justice as the State apoints, and the people must pay them what the State pleases. Whereas Phisitians have onely their personall art to make their fortunes by, which as the world goes is better done by Craft; for in medicine there is an art as well as Craft, and the latter is more profitable than the former.

Now suppose that in the King's Dominions there be 9 millions of People, of which 360,000 dye every year, and from whom 440,000 are borne. And suppose that by the advancement of the art of Medicine, a quarter part more may be borne and a quarter part fewer dye. Then the King will gain and save 200,000 subjects per annum, which valued at 20£ per head, the lowest price of slaves, will make 4 million per annum benefit to the Commonwealth. Now I consider that the through and profound search into the naturall and entire state of animalls by anatomy, and into their depraved and vitiated estate by the comparitive and contrasted observations in hospitalls, may in 100 yeares advance the art of medicine as above said. Wherefore it is not the Interest of the State to leave Phisitians and Patients (as now) to their own shifts.

Haveing premised these particulars wee come now to the severall specyes of Anatomy, the first whereof is Ostioligy, or the description of the bones, which alone would require fower Lectures. It is the cleanest and the easyest part of Anatomy, but the whole world of artificiall productions doth not afford so admirable Lessons and mechanismes as the contemplation of the

Bones doth. The second part is Myolligy,[1] or the fabrick & the use of the muscells, which are to the bones as the Cordage and Rigging of a shipp is to the masts and yards. The third is Angeollygy,[2] or the description of the veines, nerves, arteryes and lympheducts, which answers to the victualling of a Shipp and the dew despensations of all things necessary for shipps & men. The fourth is Splanchnollygy[3] or the description of each bowell, as (vizt:) of the brain, heart, lungs, liver, spleen, Testicles, pancreas &c. In all which their matter, figure, magnitude, weight, contexture, Tunicles,[4] common and peculiar vessels, scituations and uses are to be considered. And this part answers in the analogy to a ship to all those offices and work howses in and by which the severall parts and utensils of the ship are made. Wee might add unto the parts last mentioned others, which I rather call analysis then anatomy: The First whereof is the Description of the matter of bones, teeth (parts whereof are rather stones than bones), cartilages, the Tubes of vessells, the severall parenchymas, fatt, marrow, Blood, milk, sperma, urine, gall, spittle, tears, sweat, earwax, snott &c. The last part is pneumathology,[5] or the description of Insensible transpirations and Invisible Efluvia, and of the vapours generated within the severall bowells and translated from one bowell to another, as also of the sperits, naturell, vitall, and animal if any such be. Unto this part may be added the Doctrine of the motions, coctions, Transmutations, fermentations, putrifacions obstructions, exudations, Eruptions & Evaporations of all the humours, vapors, and sperits above mentioned.

It now remains to attempt such of all these specyes of anatomyes as may best answer the circumstances wherein wee are. And first lett me premise two observations: one is concerning the benefits ariseing from the desection of small animalls, that is such as are about the bignes of a Ratt, & also such as are farr greater then man, as Oxen, horses, and the like. I say that the latter is more troublesome and lesse use then the former. For in an ox's liver you may trace veins till they become capillary and then you loose them, without haveing any more satisfacion as to their terminations & inosculations with other vessels then you may have in the veins of a mouse. Now the labour of digging from the main trunks down to Capillaryes, through the massy flesh & bowells of great animals, is very Irksome. Whereas if you fleece and exinterate a Ratt, or some thin animall, you may then by holding up his extended flesh against the bright sunn (without any desection or seperation at all) disern how the vessels ly one to the other, how they cross and divaricate, with more satisfacion then the traceing of branch after branch of greater animals.

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[1] Myology, the science of muscles.

[2] Angeiology.

[3] Splanchnology, the scientific study of the viscera.

[4] The garment or membrane clothing a bodily organ.

[5] The science of spirits considered in the seventeenth century as a separate department of metaphysics.

My next prelyminary shall bee to recommend the use of Comparative Anatomy, as well in the same as in the different species of animals; for belief it, as one man may be known from another by his face, or by his Voyce, or by his tread, so one man may be known from another by every part and bowell of his body. For the bowells of every man do differ from another in bignes, shape, and substance, and the various proportion which one varieth to the other.

The other sort of Comparative Anatomy is to observe the difference between the parts of all animals from man, which wee count the Chiefe, down to an earth worm, which wee will suppose to be the vilest, that is to say the simplest, of all those that are bigg enough to be desected—altho wee may descend to the smalest animals whose parts and bowels may be diserned by mycroscopes through their transparent bodyes. For the consideracions of all these animals, I mean of those whose actions food and generation wee know, doth mightyly help to find out the true use and effect of every part.

[*Unfinished.*]

No. 130

Epulae ad ♀

Diasatyrion[1] Aqua Marina
Medulla [of] Artichoks
Spanish Potatoes } cum medulla bovina
Skerrel (?) rootes
Crab
Oyster } bene condita cum nuce moschata[2]
Scollop
Cavear
Botargo[3] } cum oleo et citro
Testiculi agni cum rad[ice] Eryngii[4]
Ova horminata [cum] Ferina[5] p . . .
Sem[en] Erucae[6] Sacchara incristata
Radices Eryngii conditae
Liquores {
Chocolate
Cawdell[7] cum Ambra-grisea[8]
Posseta cum Vino Canarino[9]
Jusculum galli cum Cantharides grs iij
Gravey of Meate cum Sago (?) Cantharides
Vinum Malvaticum[10]
Mum Brunswyck[11]

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[1] A complicated and well-known preparation which remained in the official pharmacopoeias until the eighteenth century.

[2] *Nux moscata*, the fruit we now call nutmeg.

[3] A dish made from the roes of fish.

[4] *Eryngium*, a plant much used for aphrodisiac purposes.

[5] Perhaps *hormetica cum farina*.

[6] *Eruca*, a plant also used as an aphrodisiac.

[7] Caudle.

[8] Ambergris. A liqueur called *Hippocrase*, which contains ambergris is still made at Amsterdam.

[9] A posset of Canary wine.

[11] Malmsey wine.

[10] A kind of beer exported from Brunswick and much relished in the seventeenth century.

No. 131

Opticall

1. The anatomy of the Eyes of severall animals made severall wayes.
2. The optic nerves; seeing double; the opening and shutting of the pupill.
3. Seeing circles intersect, each through 3 holes.
4. Seeing big (?) in a mist.
5. Seeing in the dark.
6. Lucid bodies of severall sorts, and phosphors.
7. Of the dark roome, with and without convexes.[1]
8. Of Prismes.
9. Of seeing by refraction in water.
10. Of specular bodies.
11. Of specula glasse and metall.
12. Of the coulers in diamonds and drops of water.
13. Of perspective and scenes.[2]
14. Of diformed bodies, reduced by plane, reduced by glasses.
15. Of convexes for spectacles.[3]
16. Of telescopes and microscopes of one convex.[4]
17. Of microscopes of one small convex.
18. Of telescopes of 2 convexes.[5]
19. [and] of 4 convexes.
20. Of a convex and concave.
21. Microscopes of 2 convexes.
22. Of Catoptrick[6] Telescopes.
23. Of Catoptrick Survey Glasses.
24. Of feyld glasse catoptrick.
25. Of different eye-glasses.
26. Of different apertures.

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[1] The *Camera obscura* which can be made to work by a pinhole without a lens.

[2] In the sense of images projected upon a screen by means of a lens.

[3] Petty makes no mention of glasses for the near sighted (concave).

[4] *I.e.*, the Galilean telescope and microscope.

[5] *I.e.*, the Keplerian telescope.

[6] *I.e.*, the reflecting telescope of which this is a very early mention.

27. Of helps for the purblind.
28. For agd persons.
29. Of diminishing catoptricks.
30. Of the eliptic sun.
31. Of great and small bodies equall upon size; of the Quadrant.
32. Of multiplying glasses.
33. Of casting figures on a wall without colours.
34. And with colours.
35. Of making figures encrease or diminish.
36. Specular bars.
37. Apparatus in the ayre.
38. To measure comets and their distance.
39. Extralawd (?) appearances.
40. Drawing pictures by a dark roome.
41. Of Helio glasses and dark glasses.

XXIII

MISCELLANEOUS

(132) Holland—(133) Of Civility and a Gentleman—(134) Ars Aulica et Ecclesiastica—(135) Of Churchmen, Physicians, Lawyers, and Soldiers—(136) Of Ridicule—(137) Wit enlarged —(138) Of Fire—(139) In Printing—(140) About the Postage of England and Wales—(141) Of a city Post—(142) Of Preventing the abuse of Oaths and Ascertaining Testimony—(143) of Taxation of Buildings—(144) Of Motion and Mechanics—(145) A scheme for Provision for the Poor—(146) Crimes and Punishments.

No. 132

HOLLAND

As a young man Petty spent a year or more (1644-45) at Leyden in Holland, where, besides acquiring the art of medicine, he wrote three Treatises: *Collegium Logicum et Metaphysicum*, a *Collection of the Frugalities of Holland*, and a *History of seven months practise in a Chymical Laboratory*. These works were, as he tells us in his list of writings (No. 158 *infra*), all lost at sea, but some notes apparently made at this time for the "Frugalities" have survived and are here printed. In his later writings Petty frequently shows the admiration of Dutch methods which had thus early been implanted in his mind.

Titles good, and worth 25 years purchase.

Lands rich, worth 50*s*. to £3 and more per acre.

Full of housing, grasses, bridges, wharfs, cranes. Defensible.

Full of straight rivers for sayles, sledges, oares. . . .

Full of people and Trade from being together.

The Country Levell, for Windmills.

Employing strangers for Soldiers.

Colonies in India. Factorys for such things as will not grow at home.

Shipping and Venture (?).

Fishing.

Equall Tax and well bestowed.

Equall representation.

No Gentlemen. Divines, Physicians, and lawyers not the greatest men.

Merchants and Soldiers.

Interest low.

All working.

Banks and Lombards.

Tolleration.
Parsimony—Industry.
Employing women and children.
Publiq ornament—buildings, shews, recreations.
Rivers, dykes, bridges, wharfes, cranes, carriage.
Shipping.
Gavell kind.
Land neere cittys.
Trade and consumption—wholesale manufacture.
Gardens, orchards, flowers, wall fruits.
Tillage—meadow, fatt cattle.
Feeding, dairy.
Breeding.

No. 133

Of Civility and a Gentleman

It would not be impertinent before this discourse to premise the signification of the words Soverain, Representative, King, Tyrant, Baron, Lord, Knight, Esq. and Gentleman; as also of the words Civitas, Citty, Towne, Village, Court, Record. Moreover of the words Merchant, Retayler, Sub-retayler, Artisan, Carryer and Ground tiller, Soldier, Priest, Physician, and Lawyer.[1]

But wee shall for the present only explaine the words Civility, Gentleman, Honor, and Love, in their common modern acceptations, viz:

A *loveth* B when hee hopes and believes hee shall or may receive many commodityes and advantages, pleasures and profits from the quality, facultyes and talents of B; and doth therefore labour to emprove the same in B; and also to persuade B that hee may reciprocally obtain the like advantages from himselfe, A.[2]

A *honoreth* B when A acknowledgeth B to bee superior to himselfe, in someone or in many desirable qualitys, faculties and powers, and by words and deedes publisheth and declares such his opinion and acknowledgement. As also that B is superior at least to one half of mankind, or of the *Civitas* and Society, whereof both A and B are members; expressing the same by severall words, gestures and actions, admitted for that purpose.

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[1] For Petty's definitions of some of these words compare *Dictionary* (No. 47).

[2] *Cf.* Hobbes on "Love" and "Hate" (*Leviathan*, chap. vi).

A is *civill*, when after hee hath selected out of the masse of mankind so many persons as hee is able to apply himselfe unto, and is disposed to love (making to himselfe a peculiar *Civitas* of friends and companions), hee doth carefully and judiciously exhibit unto each of the *Civitas* or Society all the acts and offices of Love and honor, with the outward signes—reall or counterfeit—thereof, suppressing or dissembling the signes of contrary affection.

A *Gentleman* is understood many wayes,

(1) one whereof is to be very civill, as a son.
(2) Another is to have and enjoy annuel riches, especially in Terra Firma.
(3) To have consanguinity or affinity by marriage to and with many other gentlemen, and for many yeares past.
(4) Having such estate, reall and personall, as whereby hee is able to subsist without the practise of any mercenary employments, hee refundeth his incomes in due and laudable proportions—not onely upon his owne family, neighbours, and companions, but also upon all other worthy objects and occasions—dispersing the fruites without danger of destroying the tree.
(5) Besides the last mentioned faculty, to bestow his labor and time upon just government and defence of the whole *Civitas*, his neighbourhood, and friends.
(6) Another sort of gentleman is hee who clotheth and adorneth himselfe elegantly, who hath the know-

ledge and practice of the small work hereafter mentioned, who resisteth all faillers in the signes of love and honor, and will venture his life by private fight and duell against such who faile or offend him therein; and is commonly proud to the humble and humble to the proud, affecting rather the outward signes of a lively honorable person, than the reall demonstrations thereof.

Civility or Small Moralls

To say nothing of the Great Moralls which is to hurt no man and do all men good, the Small Moralls or the arts and offices of Civility (commonly so called) are reducible to the following heads, viz:

1. To be clothed and outwardly adorned neere unto what the estate and fortune will beare, but in all case cleane and fashionable, without anything that is uncouth, obsolete and ridiculous.

2. To take away or palliate (?) anything in the body or actions that is deemed or taken to be offensive, ungratefull, or hurtfull to those with whom we converse, eate, drink and lodge.

3. To put on extraordinary ornaments or splendors when we are invited to great assemblys, or to persons and places of honour and solemnity.

4. To use the gestures, phrases and speeches of salutation (as are in request and fashion) proportionable to the person to bee saluted.

5. To answer and returne all acts and offices of civility which we have received from others—with some advantage if it may bee.

6. To tell nobody things that will grieve them, unlesse at the same time wee can tell some remedy or relief withall.

7. To expresse grievous matters in soft words, and such as do consignify some abatement of the griefe.

8. To tell the laudable things wee ourselves have done, without name, or under some other name, or as done in some other age or country.

9. When wee would please or praise an unworthy person, that wee pick out all the good actions of his life, and so sett them together as if they were all links of the same chayne; and thereby out of reall truthes to beget false ideas.

10. When our friend speaks falsely or absurdly, to bee ready with supplements, glosses and interpretations, to save him from reproach or laughter, and to shew that the like hath been done or said by persons of renown.

Concerning Visits and Compliments

1. Who is first to visit, in respect of Title, as coming to Towne from some other place? How soon the visit is to bee made? What preparations may bee made by servants, and by what servants? To whom those servants ought to apply? How far to conduct the visitant according to his quality? Who is to go foremost in all or any part of the way, and with what phrases to part?

2. How soon to returne this visit, or whether at all? or how many visits are due for one according to the quality? Whether men of office ought to returne visits which are made upon business or otherwise?

3. What are the measures of coming to dine at great men's tables or to eate privately with them? How long to stay afterwards?

4. Of sitting down to play with them at cards &c. Of the manner of being conducted to Great Men by their servants.

No. 134

ARS AULICA ET ECCLESIASTICA

Institutiones Aulicae or the Art of a Courtier

Is to get chefe favour with the chefe governor, and then to make that governor an absolute monarch, and his will to be a law. Or it is to be favorite to the said chefe favorite. Or, without being church man, lawyer or soldier, to get greater power than either of them or then the Monarch's Mistris. And all this without doing the Monarch any reall service or advantage, and much lesse the state or country.

The qualifications for this purpose are:

1. So to delight in what the Monarch delights, as zealously to promote what the Monarch would have.
2. Not to feare the breach of lawes, false reckoning, nor revolution of times.
3. To be dextrous in shift and expedient for the present day, and to face and colour all suspected actions, readily excuse all faults and interpret them to the best, and punish briskly all opponents, to stick at nothing for your or the publiq (?) good.
4. To work upon men with what presently touches their senses, and not remotely their reason; and not accept of hopes but present performances.
5. To put no value upon speculations, theories, Sciences; much less prophecies.
6. To know and make all that can bee seasoned (?) to the Monarch's pleasure, but to hinder their production (?).

Ars Ecclesiastica

1. To keep all powerfull men in feare of rewards and punishments after this life.
2. To advance the ecclesiastical above the Temporall power.
3. To presse the necessity of confession and absolution.
4. To magnify the power of priests, and their prayers, sacrifices, consecrations &c.
5. To please the people with holy days and shewes.
6. To set up artificiall, empiricall (?), experiences.
7. To confine melancholy and spectative spirits.
8. To give great alms and pardons to beggars and malefactors.

9. To governe the Monarch's Amasia, and all men's wives.

10. To have an oare in every man's boate, and a spy in every family.

11. To [be] dextrous in artificiall morals and wordes.

12. To keep laymen in ignorance.

(*Endorsed.* "Ars Aulica and Ecclesiastica.")

No. 135

Of Churchmen, Physicians, Lawyers and Soldiers

Of Churchmen

A Churchman as he bee—a Divine, Orator, or Preacher, Priest or Governor.

A Divine as he bee (1) skilful in comon or naturall Theology. (2) In the written lawes or Scriptures of his prophet or lawgiver, and in the language and critics of the same. (3) In the history of the practise, profession and worship.

An Orator—(1) In all the arts of persuasion. (2) In what hee is [to] persuade men unto. (3) The prudence of seasonable application. (4) The will and interest of the soveraigne.

A Priest—In knowing ritualls, rubricks, habits, vestements, gestures, for every feast and fast, for martyrs, apostles, various patriarchs, bishops and other saints. The use of temples, reliques, dayes, &c. The subordination of ministers.

Of Physicians, Chirugeons, & Pharmacys

A Physician is

1. To be a naturalist at large.

2. To understand the fabric and generation of animalls.

3. The diseases and deathes of them, but especially of man.

4. The senses of each disease, in its beginning, its state and determination.

5. The scales of salubrity from ayre, soile and way of life, and extraordinary disorders.

6. The art of comforting and palliating payn and danger.

7. The art of begetting good opinions of himselfe.

8. The knowledge of all medicaments in use in the place of his practise, and especially of what grow thereabouts, and of the country pharmacopoea.

9. What evills may be cured by the hand.

10. What by diett, ayres, and waters.

11. The proportion of casualties and diseases.

12. To make friends of patients and families (?), and of women, midwyves [and] nurses.

Of Lawyers and their accomplices

1. To understand the sources of suites and controversy.

2. The severall courts and jurisdictions of his country.

3. The soveraine power, legislative and executive.

4. Laws of the Nations, law of the princes, of the Church, of the sea, of forests, mines, faires, the court &c.

5. Of titles of land, property of goods. Contracts. Trespasses.

6. Of the Parliament, prerogative, Pleas of the courts.

7. Offices of sherif, justice of peace, coroner, constable, churchwarden, bailiffs, goalers.

8. What is law—viz: statutes, customes, covenant, reports of judges. Byas of present judges. Terms (?) of the Chancellor, tangent of Juries in times of faction, pleasure of the Soveraign and his Mistress.

9. The maner of bringing a case to judgement in any Court, and submitting the same, with the charge thereof.

Of a soldier

1. To be reputed not to feare death and wounds so much as not to hazard his life, at the command of his superior officer, or when he thinks tis good for the cause he serves in.

2. To believe that death is an entrance into a better life.

3. To think that *pulcher est pro patria mori*, and to believe hee shall have successe and riches.

4. To understand private combats on foot or horseback.

5. To handle and use all weapons fit for an army.

6. How to turne any number of men into all shapes, fit for any use in the fight of an army or party.

7. To understand the lawes, discipline, and language of any army or war.

8. The duty and pay of all members of an army, price of their weapons, of quarters, outguards, sentinells, spies, factions, perils, guards, implements and encamping.

9. Of all utensils and habillements for war, artillery, &c.

10. Of fortyfying, defending and attaigning, fortes and townes.

11. Of stratagems and treatyes and cessations.

12. *De Jure belli et pacis*, motives [of] rebellions &c.

No. 136

Of Ridicule

The genesis of the following paper may be found in the *Correspondence*. In a letter to Southwell of 8th April 1686 it appears that Petty, himself an accomplished mimic, had recently been extolling to Southwell the 'mimical faculty' of his son Charles, then aged fourteen. Southwell, however, refused to show any enthusiasm for Charles's proclivities. He describes himself as 'at a plunge,' for he considered mimickry to be as perilous as 'dancing on the high rope,' and he cites historical precedents (the Duke of Buckingham, etc.) to prove that mimics must inevitably come to a bad end. Petty retorts that no man could be successful as a painter, a singer, a dancer, or an orator, without the power of Imitation. He goes on, however, to draw a distinction between Mimickry, Ridicule, and Facetiousness. This seems to have appeased his friend, who contents himself with a final letter, fortified by quotations from Horace and Solomon, on the danger of Ridiculing or the 'Scorning faculty.'

The paper on *Ridicule* was evidently written at the time when these epistolary discussions took place, and it seems that Petty had actually propounded his 'fish' problem to some of his 'fortunate' friends (elsewhere distinguished as 'great men' or 'fops') and had been laughed at for his pains. His object is to show that sober truths may easily be turned into ridicule, and therefore that things which may at first sight seem ridiculous are not so necessarily.

Whereas men are apt to despise whatever they find turn'd to ridicule, sometimes to their own prejudice & sometimes to the injury of others & sometimes to both; as a caution against such mischiefe we say that anything may be turnd into ridicule as may appear by the following instances, vizt:

Pure & perfect reasoning. The noblest faculty of man, & which onely distinguishes him from a beast, turn'd into ridicule, vizt:

A proposition is made that a certaine fish, whose head was three foote long, had a body as long both as his head & Taile; and that his Taile, deducting the length of his head, was equall to halfe the length of his body. And a question offered thereupon, was how many foote long the said fishe's body was & how many his Taile?

The person to whom this Question was propounded beginns to reason after this manner & is laught at: vizt, hee says:

1. If the body be equall to the head & the Taile, then the body deducting the head is equall to the Taile alone.

2. If the Taile deducting the head (as was propounded) bee equall to halfe the body, and if the body deducting the head be equall to the Taile, then the body (deducting two heads), is equall to halfe the body, & consequently two bodyes (deducting 4 heads) is equall to the whole body; and so one body deducting 4 heads is equall to nothing.

3. If a body deducting 4 heads be equall to nothing, then the body is equall to 4 heads, and the head being 3 foote long, the body being 4 times as much, must be 12 foote long.

4. If the body as aforesaid, deducting the head, bee equall to the taile; then it follows that deducting 3 (the length of the head), out of 12 (the length of the body), then the remainder 9 is the length of the Taile.

Or Thus

(1) If the Taile deducting the head (as was propounded) bee equall to $\frac{1}{2}$ the body; then the length of 2 Tailes, deducting 2 heads, is equall to the whole body.

(2) If the body (as was propounded) bee equall to the head and the Taile, or unto 2 Tailes deducting 2 heads; then the length of 2 Tailes, deducting 3 heads, is equall to one Taile; & consequently one Taile, deducting 3 heads, is equall to nothing; that is to say one Taile is equall to 3 heads.

(3) But each head containing 3 foote, the Taile must be 9 foote, & the whole body being equall to the head (3 foote) & to the Taile (9 foote), must contain 12 foote.

Now it may be inquired into why the above mentioned discourse is Ridiculous, especially being made to men fortunate by theire wealth or power, rather than by theire understanding—which I take to be these:

1. A Fish is counted but a mean Animall, and the taile counted a vile and rediculous part of any animall. Now to apply even an Angelicall faculty (not generally knowne to be such) unto a vile & ridiculous matter (known to be such), makes the whole Composition appeare vile & ridiculous.

2. Men who value themselves onely upon the future of theire wealth or power; not redily seeing how pure & perfect Ratiocination conduces to these ends, nor remembering that they themselves ever gott anything by it, but much without it, doe perceive a disproportion between the effect and the cause, which disproportion is the ground & *Ratio formalis* of Ridicule.

3. Men of adventitious & contingent eminence doe fear (& consequently hate) intrinsick & inherent vertue, and doe express their hatred by counterfeiting contempt, their contempt by counterfeit laughter, & the laughter of many together makes the thing laught at Ridicule; and the persons concerned to laugh at this Matter are very many.

4. Ridicule is also made by likening the thing laught at to what is really ridicule, or by calling it by some name which is also rediculous. Upon which account the pure and perfect Ratiocination above mentiond (if it infect or conclude any thing against our Interrest) wee call it a *notion*, meaning therby an unintelligible & uselesse proposition, and therefore as wee need not answere. Whereas in truth wee do not answer it because wee doe not understand it, and if wee doe understand it, because wee know wee cannot refute it; & consequently the best way to disgrace it is by laughter. In which most men will be Complysant, especially if wee can brow beat them who doe not laugh at our side.

Moreover for as much as things that have neither head nor Taile are under a proverbial disgrace, & whereas most that heare the forementioned Ratiocinacon, do not perceive either the head or the taile of that discourse, although much mention were made of both, and do therefore easily laugh at it, as a thing that hath neither head nor taile—for which they are warranted by the proverb.

The 2nd instance

How great glorious & Magnificent persons & things may be turned into Ridicule, vizt:

The King of France, about the time of his riseing glory, takes the sunn for his Emblem,[1] which (as glorious as it is) is often Eclipsed by the small & dark body of the Moone.

The Hollanders at the same time, thinking well of themselves & that they could eclipse the greatness of France, take for their Emblem a Holland cheese, by its roundness & opacity resembling the moone. And herein they take an Emblem as much below them selves as the King of France did above, and by saying that the Holland cheeze should eclipse the Sun as the Moone doth, would have turn'd the King of France into Ridicule, especially if the success had Answered.

Some did also endeavor to turn the same King of ffrance with all his triumphs into ridicule, by likening that great Prince bearing his triumphall Riches to those poor fellows that carry upon their back a box of puppitts & Antick motions, which they shew to small Children for a penny & singing after a rude fashion while they so show them.

3rd instance

Things sacred & Misterious are more easily than any other turnd into ridicule, & therefore those who excell in that faculty do certainly prove them selves to God impius, but not at all to be Witts; and upon this head wee forbear setting downe anie instances.

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[1] "Le Roi Soleil," Louis XIV.

4th instance

How great & stately Poems may be turned into redicule appeares in the late Essay of Virgill Travesty.

5th instance

The Endeavors to improve naturall knowledge, the best & most pleasant of all others, have beene turn'd into redicule by the late Comedy called *the Virtuoso*,[1] onely by compareing the ends they seeke & the meanes they use to vile & rediculous matters & operations.

6th instance

Beauty in all its circumstances & the generation of man it selfe, as also strength & courage, hath been often horribly disgraced by the same Methods; but nothing hath suffered more of this kind than wisdom itself.

Wherefore things turn'd into ridicule by envious and Malicious witts are not, for that reason onely, to be despised.

No. 137

Witt Enlarged

This paper apparently has reference to Pascal's *Difference entre l'esprit de Geometrie et l'esprit de Finesse*, a copy of which was sent to Petty by Southwell in September 1685. In acknowledging the volume Petty complains that its writer "distinguishes witts by their aptitude either for Geometry or Sagacity—whereas I think that the best Geometricians were the most Sagacious men, and that the most sagacious men did ever make the best Geometricians" (*Corr.*, 21st September 1685). These disjointed notes are, however, written in a somewhat different sense. They do not attempt to follow Hobbes in distinguishing between 'Natural' and

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[1] A skit on the 'New' Philosophers, in which 'Sir Nicholas Gimcrack' and 'Sir Formal Trifle' are the leading characters. It was published by Thomas Shadwell in 1676.

'Acquired' wit (*Leviathan*, chap. viii), but deal rather with two different methods of reasoning—one from many and the other from few 'principles.' They seem, in fact, to represent an attempt on Petty's part, while equating his own principles with those advanced by Pascal, to evaluate the respective advantages of what we should now call the 'inductive' and 'deductive' systems. Petty, of course, was an apostle of the former method, though he did not disdain the latter when the necessary facts were not available.

Great and original men more [are] than are thought.

[Some have] A faculty of Deducing consequences from very few Principles.

Others deduce them as well, but then 'tis from various Principles.

Some comprehend the effect of water, touching which the principles are few, but the consequences are delicat.

Geometry takes in a great number of Principles.

Witt is of two sorts: One with vivacity and deep Inspection &c.—Ballance and exactness in their witt. Others which can take in a great stock of Principles and are fitt for Geometry.

The first sort have in their witt, vigour & rectitude; the latter, extent.

[The first is] A witt strong in a narrow compass. [The second] A witt much extended but of little force.

There is a great difference between a witt disposed to Geometry, and a witt disposed unto sagacity.

Principles plainly before one, and yet lying out of the way, to which altho' it bee troublesome to bend oneself, yet with the least care and application those principles become conspicuous.

Sight clear & sharp—witt just & exact.

Hinders subtle men from being Geometricians.

With a single glance of the eye to survey all business at once.

To prove the points of Subtilety by the Rules of Geometry.

No. 138

Of Fire

1. A Preface.
2. Description of Fire by Atomicall principles.
3. The production of fire by collissions and attritions.
4. By putrefaction and fermentation.
5. By calces, lixivial salts,[1] spirits of niter &c.
6. Of matche (?) elmewood, gunpowder.
7. Of charcoale, sea coale, turfe and their equivalency.
8. Of furnaces, stoves, ovens, chymnyes, harthes.
9. Of smoake, soote, and smoaking chimnyes.
10. Of naptha, camphor, petroleum, brimstone.
11. Of fulmina.
12. Of fusions, liquefactions, calcinations, sublimations.
13. Of distillation per ascension and decension.
14. Of candles, lamps, pharoes.
15. Of oyles and spirits of wyne &c.
16. Of rarefaction p[er] heate.
17. Of the heate of animalls.
18. Of Thermae and their causes.
19. Of fiery meteors.
20. Of lights, lucid and luminous bodyes.
21. Of the Sun its spots (and of Hell).[2]

Warming stones, firestones. Magnet of light. Making of charcoales and the species. People without fire. Burning London. Of boyling and roasting, baking, broyling. Infusion, decoction. Aeolipiles[3] with spirits—Sweating stoves. Fire eater. Scaldes. Metalls. Blowing against paper and a candle.

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[1] *I.e.*, salts containing *Lixivium* or lye, and therefore alkaline.

[2] On second thoughts Petty seems to have come to the conclusion that Hell was somewhat beyond the scope of his enquiry, and accordingly the words in brackets are crossed out.

[3] *I.e.*, closed vessels in which steam was generated by heat, in order to illustrate the force of vapour.

No. 139

In Printing

Except in the case of the first edition of the *Treatise of Taxes* (1662), the *Dublin Bills of Mortality*, and the short *Essays in Political Arithmetic*, there is no evidence that Petty himself was instrumental in the publication of any of his writings. The indications indeed point in the opposite direction. Writing to Aubrey on 29th May 1678 he expressly dissociates himself from the project of reprinting the *Treatise of Taxes*, while from a letter to Southwell of the same year (5th October) it appears that it was his friends (notably Sir Peter Pett) rather than himself who interested themselves in these matters. "I have no luck with my Politics," he says, and continues, "the solid study of other men's peace & plenty ruins me. . . . I am against printing the *Arithmetic* and wish the *Paraphrase* undone."

The *Political Arithmetic* and the *Political Anatomy of Ireland* were not published until after his death, while his early writings (No. 158 *infra*) and the great mass of his short papers (of which this volume only contains a fraction) have remained unseen till the present day.

Petty had an undoubted genius for engaging in enterprises of profit, and if the estimates in the following paper were founded on his own experiences in publication, it is astonishing that he did not make a larger use of the printing press. His calculations, it is true, are not very easy to follow, but they apparently show that an edition of 1200 copies, which had cost £2500 to produce, could be sold (? in three years) for £5400—a return which seems sufficient to satisfy the most exacting of writers or publishers.

He continued writing almost to the day of his death, but (as he sometimes tells Southwell) he did so for his own distraction, and for the edification of a few friends to whom he sent his papers. His Essays were often unfinished and seldom corrected, and it was only when nearing the end of his days that he printed those mentioned above.

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1. The Charge of composing lyes in the number of Letters, great and small, and in the form of Tables.

2. In the charge of paper—better or worse.
3. In Printing, according to the number of draughts.
4. In Inke, according to the superficies of what is printed.
5. The charge of the Presse, according to the time of working.
6. In binding, more or less beautifully.
7. In the time of setting an Impression, and the interest & risk of mony according to the medium of the same.

		£
To print 600 whole bookes		1350
and 600 set in loose sheetes		900
1200		2250
Interest for 3 [? one] yeares at 6 per cent.		136
		2386
Accidents		114
		£2500
[? To sell] 600 sets in sheete at £4	2400	£5400
600 Books at £5	3000	

demands a stock of £5000 to gett £1000 per annum.

(*Endorsed.* "Computation—Ballance the difference between the charge of composing, and 5 yeares Interest of about £2000.")

No. 140

About the Postage of England & Wales

"The Postage of Letters," Petty informs us in the *Political Arithmetic*, "costs the people £50,000 per annum, though Farmed at much less," while elsewhere he remarks that this item has "improved in thirty years from £3,000 per annum to £30,000" (*infra*, No. 148, § 75).

From the following papers we can see that he did not consider the service satisfactory and had his own plan for its improvement both in town and country.

Suppose London a center. Draw one line from thence to Spurn head neere Hull, & another to Exmouth; which two lines will make an angle of about 120 degrees, and will bee of such a length as 8 horses can go in 30 howers (*i.e.*, 150 ms at 5 ms an hr). So as each horse goes about 5 miles an hour for 3 howers together, repeating the same 4 times a week, with long intervalls of rest between. But probably the same may better bee performed by men exercisd in it; by reason footmen can go where horses cannot, & for that a footman can carry about 8 ℔ weight, which is as much as any packet of letters can amount unto.

Letters may be sent & answerd every 24 howers within 30 miles of London; and every other day within 75 miles; & every 3½ dayes (or twice a weeke) at 150 miles distance; & every 6 dayes from any part of England or Wales.

If a Carryer cost 10£ per annum, Then the charge will bee 3*d*. per letter, if one letter go to each place forth & back, so as all above will be gayne.

Some calculations ensue, which are not easy to follow, but Petty seems to have arrived, amongst others, at the following results:

That there would be 558 'carriers' in all, to go 150 miles twice a week, who would be paid 4*s*. each per week—making £111 12*s*. a year.

Others to go 'the whole once a weeke' would receive £21 12*s*., while the 'daily post' and the 'two days post' figure for smaller sums.

There is a rough diagram amongst his notes from which it appears that he attempted to work out this problem by a system of triangulation!

No. 141

OF A CITTY POST

1. Query in what time the Post can run the perimeter of the Citty?

2. How many miles of street are within that perimeter?

3. How many miles of street The In-post can run, whilst The Out-post runs the perimeter?

4. Divide this last by the whole number of miles & It shall give the Numbers of Bureaux to bee placed upon the perimeter.

5. Describe the Citty into as many Cantons as there bee bureaux upon the perimeter.

6. The hower & minute must bee fixd on which Each In-post must bee at his respective Bureau.

7. Let the In-post weare a distinguishing habit, & use a distinctionall Pipe, to give Notice of his passage.

No. 142

OF THE PREVENTING THE ABUSE OF OATHES AND ASCERTAINING TESTIMONY

1. Let every person of 18 yeares old bee enjoynd to have a seale, on which let bee engraven his name and time of birth; the colour of his eye, and hayre, shape of nose, in cabula[1] whereby it may *semper constare de personâ.*

2. Instead of 2 Indentures, let there bee 3 parts, whereof one to bee deposited by consent of parties.

3. Let all witnesses expresse with their signatures (besides their seales) the place of their then residence; the day, hower, house, and roome, when and where they signe as witnesses.

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[1] ? intaglia.

4. Let deposited writings or Counterparts bee of 3 sorts, viz: one publick, another entrusted to the *Custos*, and the third to bee deliverd seald up; having the date, the name of the bringers, and 5 words of the writing, with the line and place of the line where each stands, and the number of lines in the whole.

5. Let all bonds, bills, agreements, promises &c. bee in writing; thus to bee deposited and in 3 parts, *ut supra*.

If a witnesse be examined long after the fact, let that produced swear hee knowes not the contents of past examinations, and cannot tell within 3 days to the knowledge of this witnesse.

6. When any injurious, defamatory, or otherwise criminall words are spoken or acts done, let the witnesses thereof bring to the *Custos* of the place where the words were spoken or acts done, a narration of the same *viva voce* within 24 howers, which let the custos put in writing without giving the Narrator any Coppy; and let notice be given thereof with all speed to the party accused.

7. If any evidence arise elsewhere than where the crime was done, let the same bee notifyd to the *Custos* of the place itselfe.

(A fact may be contrived in one or many places, and at many times, tho executed at another.)

8. Let the accusd or litigant partyes send crosse-interrogatryes to the *Custos*, who thereupon may call for answers speedily.

9. When the Court gives orders for publication, let the *Custos* make breviats of evidence patent to the Complaint and Defence, and bee ready with the originalls in Court.

10. Let conveyances of lands bee publicq. [Let] bills, bonds, and agreements *de praesentis* [be] knowne onely to the *Custos*. Let promises &c. *de futuris* bee sealed.

[*Inadmissible evidence* [1]]

1. No testimony of words spoken above 7 years ago, not putt in writing, to bee good; nor of acts done above 21 yeares, without cause shewn and allowd [by the] soveraigne.

2. Likenes of handwritings of dead persons.

3. When witnesses cannot tell the chiefe points of the deed.

4. When deeds contradict possession and enjoyment.

5. When counterparts are lost or never made.

6. When the keeper of the deeds cannot prove the succession of the *Custodia*.

No. 143

On Taxation of Buildings

The ensuing paper must have been written after the rebuilding of London consequent on the Great Fire of 1666. It may be compared with *Heads about rebuilding of London* (No. 9 *supra*) in which the writer suggests a loan in aid of the restoration of the city, to be raised by a general tax and repaid in seven years. Elsewhere (*Political Arithmetic*, Hull, 308-309) Petty tells us that in the four years succeeding the fire, the Building Trade made £4,000,000, over and above their average earnings. It was probably with some idea of taxing the 'profiteer' that the levy on new London buildings was now suggested. There is something curiously suggestive of modern discussions on site values and 'unearned increment' in the arguments Petty adduces to show that the Tax will fail to reach those for whom it was intended.

Whereas 400^{m}£ is thought fitt to bee forthwith raised for his Majestys service, and whereas It is propounded to raise the same upon the new Buildings in the skirts of the Citty of London. It is humbly offered to consideration as followeth, vizt:

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[1] No cross heading in MS., but the sense is clear from the context.

1. That the New Buildings in the skirts of the Citty of London, are not $\frac{1}{100}$th part of the Lands, Goods and Chattles of the Kingdome of England, Dominion of Wales &c; and consequently that to raise 400^{m}£ upon the said new buildings, is the same as to raise 40 millions upon the whole Kingdome.

2. That to raise one year & a half's full Rent of the said new buildings, is to take $\frac{1}{8}$th part of the whole vallue of the said Intrest, and nothing from the rest of the whole nation; which is contrary to the nature of a publiq ayde. So as the said Levy must bee, not a publiq ayde, but a particular mulct or penalty upon some particular sort of offenders, namely the Builders upon New Foundations.

3. That this mulct or poenalty will not light upon the propper offenders, or builders upon new Foundations, but for the most part upon the Buyers or Purchasers of the same.

4. That the Rent of the new buildings doth consist of about $\frac{2}{10}$ths for the vallue of the ground, $\frac{5}{10}$ths for the shell of the Howse, and $\frac{3}{10}$ths for the finishing of the same. So as great questions may arrise whether the intended levy is to bee made out of some one or two of the said particulars, or out of all three.

5. It is to bee considered whether the said Levy is to bee made from the Tennant of the Howse, or from the Owner of the Ground Rent, or from the first Builder.

No. 144

Of Motion and Mechanics. 1686

1. That the vibrations of a pendulum are of equall times.

2. That the time depends upon the length of the string, or distance from the centre of the motion or movement, to the centre of gravity.

3. That the times are to these distances in proportion of squares.

4. How 2 movements on each side of the same center do alter the time of vibration.

5. How strings of a certaine length make an angle and a new center.

6. Sharp notes in Musicall strings is many vibrations in the same time.

7. A Body falling from on high doth not fall equall spaces in equall times, but in certaine proportions.

8. Globes falling different numbers of their owne diameters, fall with different force and impulsation in certaine proportions.[1]

9. Measure these matters in ayre and water, land &c, upon pullyes.

10. Try the difference of longer and shorter parallellipedons[2] with the same force.

11. Try how sharp angles facilitate motions and in what proportions.

12. How soape or tallow facilitates motion.

13. How the same body cloven (?) and having greater affriction with water goes slower.

14. Make these experiments both by traction and pulsion.

15. Try in what proportion of swiftness different weights draw the same body.

16. The proportion of facility through water, over a plaine, upon 4 wheels of several diameters.

17. Upon affriction of smooth superficies, and sled-like bottomes.

18. The difference between the weight a man or horse can carry or draw upon wheeles.

19. What he can carry, tosse, or throw; viz: how many times his owne weight.

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[1] Newton had expounded his theory of gravitation in *De Motu Corporum* two years before this was written. It was elaborated in the *Principia*, first published in 1687.

[2] Parallelepipedons, solid figures contained by six parallelograms, every two opposite sides being parallel.

20. How many times their owne height severall men and other animalls can leape.

21. What difference in the swiftness of animalls, Man, beasts, birds, and fishes.

22. What difference in the duration of their motions.

23. Of the bias of bowles. } as to Motion.
24. Of rudders of ships. }

25. Of feathers of arrowes.

26. Of the motion of water in rivers.

27. Of wind in sailes.

28. Of pendula moving one against another, being of severall weights and magnitudes.

29. Of the figures and roundness (?) of many bodyes.

30. Of the motion of sounds.

31. How far any gun can shoote.

32. Of recoyling of guns, and progression of the bullet.

33. The motion of arrowes.

34. The force of hammers and of their use; of their severall weights, figures and materialls.

35. The weight of breaking woods and ropes, bending metalls.

36. Of presing and battering.

37. Of the Leaver and beame and gates.

38. Of pullies; single, double, and treble &c.

39. Of raising weights by blast and bladders.

40. Of screwes.

41. Of wedges.

42. Of motions uphill and downehill.

43. Of motions through dirt and Asperities (?).

44. Of compounded motion of men, in ships and coaches.

45. Of the zone wherein any part of a projection moves.

46. Of the motion of the center and parts in severall parts of a wheele.

47. Of Tennis balls and Racquets.

48. Of billyard balls.

49. Of the motion of Roquet and fireworks.
50. Of canting boates with poles.
51. Of glasse drops and their breaking.
52. Of bombes.
53. Of Fermentation.
54. Of the Heart and muscles.

No. 145

A SCHEME FOR PROVISION FOR THE POORE. 1687

1. Let an exact accompt bee made of Every man, woman and child within each parish.

2. Let all that please, or others for them, make knowne their wants and cause of the same; and what kindred and relations they have; and where borne or bred.

3. Let those who are admitted to reliefe bee distinguished into 3 classes

    (i) Impotent in whole or in part.
    (ii) Who can work, but want employment.
    (iii) Who are able bodyd, but know not how to work.

As to reliefe

1. Let some be sent to their country & friends.
2. Others have work and Masters assigned them.
3. Others receive proportionable almes.
4. Others have a Badge & licence to beg.

Let an exact accompt bee made for the last 7 yeares of all receipts & payments made for the poore, and first for the last yeare itselfe.

No. 146

Crimes and Punishments

This paper, though in the original headed "Bankrupts," deals (as will be seen) with various forms of crime, and their punishments. From its general tenor, and its suggestion that prisoners should be kept in Ireland, it may have been intended to apply to malefactors in that country, rather than to criminals in England.

Helps whereby it may bee knowne:

1. Whether any Bankrupt doth not pay his debts:
   (1) Because hee concealeth his effects,
   (2) Because hee hath vainly spent his estate and Creditt,
   (3) Because hee hath lost the same by negligence, Ignorance, and Credulity,
   (4) By Inevitable Cawses.
2. How Robbing upon the Highway may bee prevented.
3. The same of Burglary & Burning of Howses.
4. Of Stealing Horses, Oxen & Sheep.
5. Of other portable goods.
6. Forging of Deeds.
7. Of foisted, changed and vitiated Deeds.
8. Of cheates & frawdes.

How the Persons guilty of all and every the aforementioned Crimes, may bee known and detected.

How being detected they may bee taken or kept safe as Prisoners within the Island of Ireland till they be taken.

Proper & proportionable punishments to each of the said Crimes, in order to Right and Reveng.

Some of the helps to the premisses:

1. That all men bee bound to keep Accompts of their Receipts and Issues, Gayn and Losse, Debts & Credits, in mony, Cattle & Goods, and where they were at noon and at night every day in the yeare; with mention of what deeds hee hath made or wittnessed.

2. That no howse stand alone, nor without call of some other howse. But that 10 Howses may stand neer together, and as neer as may bee in some High Way; and that one of the said Howses bee an Inn, and the Keeper thereof a Cunstable, tything man or other officer, with good security for his good behaviour.

3. That every man have and cary about him an uncounterfitable Tickett, expressing his name, the numero of his Howse, his Age, Trade, Stature, Haire, eye, and other peculiar marks of his Body.

4. That every man of —— have a peculiar Seale.

5. That the High-ways bee guarded.

6. That all Cattle bee disposed of in marketts & fairs.

7. That speciall Ports & Vessells bee appointed for going in and out of the Kingdome.

8. That an office bee instituted for recording the peculiar marks of any Deed or writeing, without knowing the Contents of the same.

9. Where a crime is committed by many, That pardon be offerd to one who shall discover the fact, within 3 monthes & not before one month.

10. Upon what grounds Accompts may be suspect.

Of punishments

1. Pecuniary mulcts }
2. Forfeitures } for damage to the publiq.
3. Banishment—for useless persons & cowards.
4. Servitude & Slavery—for spendthrifts, bankrupts, debauchers.
5. Corporall paynes—for fornications, quarellers, cheates.
6. Exposd to shame & ridiculous habits—for Lyers, cheates, bawds, pimps.

7. Secluding Imprisonment—for plotters, heretics.
8. Castration.
9. Incapacity of Office, Trust, Testimony—for Judges, Officers, Witnesses.
10. Exposd to Military danger—for homicides, hesters (?).
11. Branding & Stigmatizing—for Thieves, rogues, blasphemy.
12. Simple death of severall kinds—for murther, great robbery, burglary, bankrupts (?).
13. Dismembring—hands, eyes & eares. Thumbs for forgers, Testicles [for] P . . . eyes [for] adultery Eares for Plottes sedition.
14. Torture & death—for repeated murthers.
15. Bedlam—for witches, Scepticall hereticks (?).

XXIV

OBSERVATIONS

(147) Natural Observations (Observationes Medicae **et** Praxis)—(148) Political Observations.

OBSERVATIONS

PETTY frequently set down his views on current topics in the form of 'Observations.' In his first list of writings (No. 158) he enters, under date 1652, *Observationes Medicae et Praxis*, and under 1660, *Observations on the Bills of Mortality*. He published *Observations on the Dublin Bills* in 1683, further 'Observations' on the same in 1686, and in 1687 *Observations on the Cities of London Paris & Rome*. His letters to Southwell show, moreover, that he constantly made use of this term when expounding some new matter for the benefit of his receptive correspondent.

Of the two papers which follow, the first, which I have called "Natural Observations," is an (unfinished) English version of a Latin document amongst Petty's Medical MSS. That both were written before 1655 is evident from the appearance of the paper and from the very small and neat script which is characteristic of his earlier works. Neither the Latin nor the English version bear any date, caption, or endorsement. I think there can be no doubt that they are the *Observationes Medicae et Praxis* mentioned above and that they were written in 1652.

The 67 Observations in English constitute less than a quarter of the original version as written in Latin. The remainder appear to be of the same somewhat discursive and quasi-medical character as those which are here given. I have not, however, attempted to translate or to print the Latin version.

The second paper (No. 148) consisted originally of 137 observations, though the first 43, together with the heading (if any) are missing. I have called it, in contradistinction to No. 147, "Political Observations." Its date (1671) is supplied in the context. The Introduction, which I have printed at the beginning, occurs curiously enough in the middle of the MS., on the back of the sheets containing Observations numbered 112 to 114. It seems, however, to fit the material which follows, though it was probably no more than a draft.

The relation of this paper to Petty's *Political Arithmetic* is not easy to determine. The year in which the *Political*

Arithmetic was written has been a moot point. One of the finished MSS. is marked 1671, and Petty himself gives it that date in the list of writings already referred to (No. 158). Nevertheless Hull, after reviewing the evidence, inclined to the opinion that it was not written till 1672—and this conclusion is, I think, now proved correct.

The " Political Observations " could scarcely have been contemporaneous with the *Political Arithmetic* as printed, for some of them are actually reproduced in that Essay. It may well be, therefore, that when Petty speaks of ' Political Arithmetic ' in 1671, he means not the essay, but these observations, and that when the essay was afterwards written the ' observations ' were laid aside and forgotten.

Some years later we find Southwell asking Petty whether he had ever, as he once intended, " Writt down a sett of cases in the way of Political Arithmetic, in order to instruct and settle the present age in this method " (*Corr.*, 13th October 1685), while on 10th March 1686 he recalls that this ' set of cases ' were to be known as " Petty's Reports." The ' set of cases ' which Southwell desired to obtain in 1685 were apparently no longer forthcoming, but it seems not at all unlikely that they were concealed none the less somewhere amongst Petty's fifty-three chests of papers, and that they were none other than the second set of (Political) Observations printed in the section which follows.

No. 147

NATURAL OBSERVATIONS

[? *Observationes Medicae et Praxis*]

1. Many have beene hurt by going to stay a Canon bullet, when (the motion seeming to bee extinct) it rowled along gently upon the ground; some in france lost their foot by attempting to stay it therewith.

2. Gunshott wounds are accompted malignant, that is to say, have somewhat in them not producible neither by simple solution of continuity nor combustion.

3. The sting of a Bee, or thorne remayning in the flesh of a living animal, exciteth much paine, rednes, and heat in the part.

4. Amber rubbed upon ones clothes attracteth strawes, small peeces of paper, and some other such light substances; but chaffed against the bare warme skin, acquireth no such faculty.

5. An earth worme beareth rather the signature of a gutt, wherein others like it breed, then of a nerve; consisting of many annular whitish fibres (answering to the transverse fibres of the gutts), by the contraction and gathering together whereof it moveth; and having also both its extremitys not unlike the pylorus & anus of a gutt.

6. I have alwayes found earth in the worms belly, and have observed in gravells, wastes, where they have broken up, many small hillocks of earth of the bignes of an hasell nutt, which are no more like to bee the excrement of the worme (which he cannot voyde but above ground) then a molehill is the excrement of the mole—Although some have thought it; affirming moreover that such excrements are the quintessence of earth moulds, and almost the sole cause of grasse, in so much that where no wormes are none or little grass can grow. Whilst others of contrary opinion have thought worms to bee destructive to grasse, feeding upon the Rootes thereof.

7. Wormes exposed to the hot summer, doe dye suddenly thereupon.

8. If the ground wherein wormes lye bee shaken, they come forth in abundance, for feare (as some thinke) of the mole their enemy, who in rising, causeth a like trembling of the ground.

9. Thongs of leather cast into an hott oven, or layd on an hott fire hearth, move and wriggle about like eeles.

10. Young Whelps, and all new borne Creatures, as soon as ever they are borne repaire to the dugge, and fight or strive one against another for the better dugge,

before they can learne by any experience that there is either milke in the dugge, or that such strivings will availe to the procurement of the fuller teat.

11. Bloodhounds have a strange perfection of sent, whereby they are able to follow the footing of a man, by those small & subtill effluvia or expirations which passe through his shoes into the ground; even three days (if the weather bee hott) after the party whom he senteth hath passed that way.

12. If a man that feareth to bee pursued by those hounds, lay pepper or some strong sented thing in his footsteps, or goe sometymes with his shoes on, and sometymes of, It is affirmed by many that the Bloodhounds will be so disturbed in his sent, as to loose the footing of the pursued.

13. Mosse growes upon metalls, stones, or dry woods lying without doores, although very remote from the earth, but chiefly where water is alwayes dropping downe. This mosse is of diverse coulours, sometimes greene, sometymes yellow, sometymes like rust.

14. Flowers are of fairer coulors then the other parts of the plant. Silke is capable of a fairer then wollens. Glasse, gems, salts, and all polite bodies, receyve beautifull coulors.

15. Flowers most comonly grow upon the Extremity of the plant.

16. I have observed that, in many severall flowers, I have still[1] found severall species of small flies and other insects.

17. Severall matters putryfying produce differing insects, as a man's dung maggots—unlesse those maggots while they were within the body were by reason of their smalnes invisible, and fed after their extrusion to the bulke whereof wee have seene them, and consequently not bred by putrefaction of the excrement.

18. Gall cast into pure water praecipitates, and so

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[1] *I.e.*, always.

doth blood, but not so quickly as gall. It mixeth with the water & couloreth it, but not very easily. Dryed or evaporated on a quick fire [it] leaveth a matter like Aloes, and of a sternutatory quality.[1] Distilled, it yeildeth a cleere water, which when it hath stood some few dayes, is of pleasant smell, faintly resembling musk, and abstersive, as the gall itselfe is (being used in lixires to help the scouring of the soape and to sent the Buck[2] of linnen). When halfe the gall is distilled over, the remayning halfe is of a greene colour, whereas at first it was yellow. If you anoint one side of the brim of a spongy hat with gall, blow spittle through the hat, a great frothy Lather will arise like that of soape. It is used with success by some on Clysters. A Barrow hogs gall, dryed in the Bladder, is kept by country people as a Remedy to extract thornes out of the flesh.

19. In Brutes the connexion of the *Os Sacrum* with the *Ilium* is incomparably more laxe and loose than in men, which may bee the cause of easier deliveryes of the *foetus* from the one then the other.

20. The Brayne of a Catt (accompted poison) being given to a dog & another catt in a very great quantity, produced no harme to them that I could observe.

21. Ligh[3] that is made by many repeated cohobations of water upon our common wood ashes, is of the colour of urine; stale beere is of the same.

22. Ashes doe differ much in the degree of their absorptive (?) faculty. In potashes it is strong, in ordinary wood ashes weaker, in turfe ashes scarce perceivable.

23. In a certaine chamber where many mice were seene to runne daily and familiarly up & downe, there was a catt dissected & her flesh boiled; after which tyme the frequency of mice was scarse observ-

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[1] *I.e.*, which causes sneezing.

[2] The lye in which linen was steeped before washing.

[3] Lye or *lixivium*—any alkalized solution.

able, whether for that or no, may be tried by further experiments.

24. One that had greased his bootes with dog's grease, was a long tyme after molested with the barkings & accursions of other dogs.

25. The powder or shaving of Brazil wood[1] maketh water of the coulor of claret wine, and a few drops of sharp vinegar, juice of limons, or any other acide liquor, beeing putt into the water so coulored, turneth it into the colour of faire urine; but a few drops of Inke (or a little powdered vitrioll, as I think) putt in the stead of vinegar, turneth the said red into a faire blew or violet colour.

26. The same effect doth not follow if the water bee rubified with lake or some other tinctures.

27. If a small quantity of spirit of salt or vitrioll bee mixed with the syrrup (or juice, as I thinke) of violets, the compound will bee of an orient crimson red.

28. The juice of violets kept a day or two staigneth greene.

29. A prisme of cleere glasse, sett with the Angle thereof toward the nose, representeth many beautiful colours to the sight, lying one to the other like those of the Rainbow.

30. In walnuts, cheese, metalls &c, putrifyed or dusted, are seene great variety of coulors, but irregularly. Such things also acquire a more sharp and biting tast than they had before.

31. The bottome of a boiling pott is not so hott but that one may putt his hand under it, with the least harme of danger of scalding.

32. Moist hay and other herbs layd in heapes heate very much, insomuch as sometymes to breake out in flames.

33. Fire is procured by the allision of a flint and steele, [or] of some other hard stones, or by 2 such stones

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[1] *Caesalpinia Sappan.* This wood gave its name to Brazil—not Brazil to the wood.

striking one against the other, but more weake; or out of a knife in whetting &c.

34. At Amsterdam, where they use sledges for the carriage of all greater burthens, they place at the head of the Sledde a leaking barrell of water to prevent its firing.

35. A knife or other like them, beeing putt into the fire, comes forth spotted with sundry sorts of coulours irregularly layd.

36. Take a new peece of silver and haveing skoured it very cleane with fine sand and water, dip it lightly into stale urine, or the mudd of pissing places, diluted or temperd with water or other urine, and it will become of a faire gold colour. After which tyme if you continue to dip it, it becometh variously coulored with red, yellow, greene, blew &c; and if it lye in the said Tincture becommeth at last of the colour of new Iron.

37. Fire is as easily quenched with hot as cold water; and as easily by exclusion of aire, or compression of the combustible matter, as by the affusion of water.

38. Oiles, fats, camphire, &c. accompted either cold or temperate by Physicians, burne more furiously then pyrethrum, euphorbium, arsenicum &c., hott in the 4th degree.

39. A skayne of yarne or long shred of cloth beeing first wett, and then one end thereof putt into a vessell of water, the other hanging out lower then the water is, will draw out the water till it become equall in heighth with the end that so hangs out.

40. If a stroke bee made at a man's head, hee presently & before any deliberation, holdeth up his arme for defence. If the blow bee made or offered at his eye, though by one whom he knoweth will doe him no harme, yett hee suddenly and as it were against his will, shutteth his eyelids.

41. Man and other animalls Scratch where it itches, naturally.

42. Oile & water are as to sence perfectly mixed in the body of plants, and are separable by distillation.

43. Blind men and others that have used themselves to it, will by the mediation of a staffe, discerne and judge of the substance of those things which they shall touch by the said Staffe.

44. Oleum Tartari *per deliquium*, or the liquor of tartar made of its salt dissolved in a moist place, mingled with spirit of Vitrioll, causeth a vehement heate & Ebullition. Spirit of Vitrioll mingled with cold water doth the same, but more remissely.

45. A glasse very much heated is broken with a suddaine cold coming upon it, or by the application of a wett thread, in that very place where the thread is applied.

46. Leather soaked in spirit of niter becometh like bird lyme.

47. The flegme of Vitrioll, or the Spirit distempred with water, cleanseth black teath.

48. Rhubarb, worme seed, & some other things give Urine (being taken inwardly) a yellow colour.

49. Common salt is calcined and dryed with the fire, and may also bee melted therewith, and dissolved in water.

50. Salt druncke with water causeth loosnes.

51. Water will dissolve but a certaine quantity of salt or sugar.

52. Salt or Saltpeter mingled with snow accelerateth the condensation of water into Ice. If the said matterialls bee put into a pewter pott standing upon a wett stoole, the stoole will be frozen to the pott.

53. A needle, layd gently upon the superficies of a still vessell of water, swimmeth.

54. The Calces of metalls may be reduced into metall by admixture of saltpeter or some borax, and melted together with them.

55. Anything wherein [is] Quicksilver, if mingled with a double or treble quantity of unslackt lime, and

distilled in an earthen retort with a strong fire, will yeeld the quicksilver up againe.

56. Cockles or oisters, beeing either boiled or washed, open of themselves.

57. Cockles open themselves towards the incoming of the tide, to receive in water. I have also observed cockles not yett dead layd out all night in a garden, to open themselves, which as soone as they were toucht with a knife shutt themselves fast againe.

58. If a dish fild with water bee placed betweene the spokes of a wheele, and that wheele bee violently turned about, neither the dish nor any drop of the water in it will fall out of the wheele.

59. If one move a firebrand lighted at one end, very swiftly either in a straight or circular line, there will appeare either a line or a circle of fire of the breadth of the top of the brand.

60. The Herbs Orpin, Saponaria, Mallows, parsetariae, cabbage & others, beeing either rubbed betweene ones fingers or macerated in warme water, become very slippery & Scowring (?).

61. If an Egge bee squeased or pressed never so hard, length wayes, it will not breake.

62. If an Egge be sett upright a long time in sands, the yolke will settle so hard to the bottome, that by the poising thereof it will stand upright.

63. Blood being cold curdeth into a jelly, the serum or whey thereof swimming seperately at top. The upper part of the said jelly beeing of the thicknes of 2 halfe crownes, of a very faire bright red coulour, and the rest underneath it more black. If the said blood be putt into water and then squeased betweene the fingers, it will bee found fibrous and stringy, having the seeds of flesh in it. Some blood appeareth in its superficies of divers colours, & some will never cake or curd together.

64. About the spring tyme, small white scalings doe flower out of mens faces.

65. If a man turne himself round apace and then

(having shutt his eyes) stand still, hee shall thinke that himself and all things stand still. But if hee open his eyes & fixe them stedfastly on some one object, that seeming gyration ceases; or if hee turne him round awhile the contrary way—unlesse hee doe it so long that [he] become giddy again.

66. A *Lixivium* of Tartar, calcined to blacknes, fetcheth off both spots and ill sents from the hands.

67. If scarlet cloth bee layd to steepe in liquor Tartaris, and the end thereof bee hung in a vessell of faire warme water, with the other end hanging without the said vessell and lower then the other, the said warme water will passe over through the Cloth and bring off its colour with it.

No. 148

Political Observations

[Introduction]

Having observed how many useful Truthes were lately distilled out of dry Bills of Mortality, I have furnished a more juicy matter to the Assembly of Reason; and I believe there is Salt, Sulphur, & Mercury in every of these 100 Observations, and that from them by due processe may at length bee made the Laudanum of peace, and Elixir of plenty, and the Mercury of our Unsettlement fix'd. They seeme to bee in no order, nor is the reason of the tumbling Composition seen—no more then that of the Ingredients with the great Theriaca.[1] And yet there is nothing put in by chance or negligence, but every the most heterogeneous paragraph tends to one point & focus.

Some of them are not so very true as I could have made them; neither doth the Scripture give the exact properties between the diameter and circumference when it sayth that Solomon's sea of brass was 30 cubits about & 10 over.[1] Some I knew not how to get downe truer; but they are all true enough to prove what is intended. I wish I knew whether to buy a Rheme of paper of no lesse true or usefull positions, mixd with so little of what is otherwise; and I wish that any careful observer of the world would freely amend whatever hee finds amisse, before I myselfe build too much upon them.

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[1] Poison antidotes.

To shew what kind of use I intend to make of them I shall onely at present offer the 6 Inferences following, chiefly as a specimen of my method of reasoning [and] of the means whereby I hope to prevent the labor of writing long books. And as this proves true, as I am able, I shall proceed; not despairing of coadjutors that will sublime and ratify what I have but digd, and at most calcined.[2]

* * * *

44. The lands of all the papists (?) in the house of Peeres, are not $\frac{1}{10}$ of the whole. Their personall estates not $\frac{1}{100}$, and the number of their wives & children, brothers & sisters not $\frac{1}{1000}$.

45. The Revenue perpetually affixed to the Crowne is scarce $\frac{1}{1000}$ part of the produce of Land, Stock & Labour of the whole nation.

46. The Lands belonging to Bishopps, Deans & Chapters, as also to Universitys & Colledges, together with the value of appropriate tythes, are not worth one million per annum, but are [the] motive that makes differences in religion. For to gayne that good position (which men think due to those who can teach the best way to heaven) many competitors study to

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[1] *I.e.*, in diameter. The scriptural passage in which Petty had characteristically discovered an exposition of the properties of the circle, will be found in 1 Kings, vii, 23: "And he made a molten sea, ten cubits from the one brim to the other. It was round all about, and a line of thirty cubits did compass it round about."

[2] The six Inferences mentioned above, as well as the first 43 of the "Observations," are unfortunately no longer extant.

propose something which they hope will passe for such with the people.

47. In Ireland tis not cleere and certayne where their Soveraigne power resides, whether in the Parliament of England or in that of Ireland. If in that of England, they are not all represented, and so fall into the position of Conquered People; though themselves bee the Conquerors by the Authority of England. If in Ireland, the Conquered have the same advantage with the Conquerors, but neither more than a negative of what the K[ing] offers.

48. Anno 1640 $\frac{1}{3}$ of all the Lands in Ireland belonged to the Church and to Protestants. Of the remainder the Irish Papists have lost $\frac{4}{9}$ by the late Settlement; So as now the said Irish have but 10 parts of 27, and the Protestants about 17.[1] But the Papist Inhabitants are 5 to 1 of the Protestants.

49. 40*s*. per annum makes a freehold in Ireland. Wherefore the Irish papists have not lands enough to make more papists freeholders then there are Protestants of 21 years old in all Ireland. They can outvote the Protestants in Elections to Parliament. The same may almost bee sayd of Corporations & Peers.

50. The differences in Ireland are sayd at this tyme to bee between Protestants & Papists, they were as great before the Reformation between English & Irish. But indeed they were then, & now, between the rich & the poore—the contented & discontented.

51. The King's Revenue in Ireland this anno 1671 is neere Treble to what it was anno 1640.

52. Of 33000 English Soldiers, who reduced the rebellion of Ireland, not 10 have £1000 per annum, nor $\frac{1}{10}$ of that number any Lands at all.

53. All the debentures of all those soldiers might have been bought anno 1654 for lesse than £200,000, & accordingly were bought & sold in the free & open

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[1] But by Petty's own calculation the figures should be $\frac{12}{27}$ of the land in Irish, and $\frac{15}{27}$ in Protestant hands.

markett. But the Quitrents now charged on forfeited lands are now worth one million to be sold.

54. Of all Lands belonging to Irish Papists anno 1640, 5 parts of 9 have remaynd or been restord to the said Irish.[1]

55. The number of Irish soldiers sent away to Spayne, France & Flanders between the years 1651 & 1654 are near 35,000 men, whereof not above $\frac{1}{10}$ returned.

56. The charge of reducing the Rebells began anno 1641, and continuing under one forme or another to 1653 (viz: about 12 yeares), amounts to above 10 tymes as much as all the Lands of Ireland would have been sold for in the said year 1653.

57. The herrings taken by the Hollanders yearely are sold by the fishermen at first penny (?) for above one million per annum; but the Hollanders gayne by sending the same first into severall parts of the world, and by the first returns of the same (by good estimates) 4 million more.

58. The East India Company of England pay yearly about £90 to £100 freight, at under £20 per ton of goods.

59. The Hollander *in Mare* gayne 60 for 1, and in many other commoditys 10 & 12.

60. The Customes of the port of Bristoll are about $\frac{1}{5}$ of the whole Kingdome, & those of London $\frac{2}{3}$.

61. The Customes of Ireland are somewhat lesse than those of Bristoll.

62. The Citty of Dublin is but $\frac{1}{10}$ of London, and

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[1] This statement, with that in § 52 above (namely, that in 1671 some 3,000 only of Cromwell's soldiers remained in possession of forfeited estates) is of historical interest. Nobody knew more of the distribution of Irish land at this time than Petty and it would seem that, in point of its results, too much has been made of Cromwell's 'Hell or Connaught' policy. Petty's own rent books for co. Kerry show that, although the local chieftains had been compelled to surrender their positions as overlords or recipients of 'head-rents,' their former tenants, generally speaking, remained where they were before the Rebellion.

the Excise of Ireland about $\frac{1}{10}$ of England. But the People of Ireland are $\frac{1}{5}$ of England or thereabouts.

63. Twas thought that the Cattle Trade of Ireland made the rents of England to fall 4*s*. in the £, or 1,600,000£ per annum in the whole. Whereas in no yeare the value of all the Cattle brought thence into England was neere worth $\frac{1}{10}$ of that said sum.

64. Ireland, since the prohibition of the said Trade, hath exported of the proceed of their cattle to the same value, though in other species: viz: so much more of butter, cheese, salted beefe, hydes & tallow, than what was included in Live Cattle, sheep & Oxen.[1]

65. After and in the building of London, the price of Lead & Fir timber, and of severall other materialls, as also of workmanship, grew cheeper then before.

66. The Plague anno 1665 took away the same quota of the people (viz: about $\frac{1}{5}$) as the Fire, anno 1666, did of the housing.

67. New built housing to the westward of Temple Bar are well tenanted; but to the Eastward, within the libertyes of the Citty, not so. Because these latter can bee lett only to freemen, and such Tradesmen who have stocks, and are provided to sett up their Trade and are not already fitted elsewhere; whereas the others are free to all the world.

68. The Coales brought from Newcastle in one yeare to London are 270,000 Chaldrons, in 3100 tunnes of shipping.

69. The Fir timber & deals brought in Anno ——.[2]

70. The Brandy brought from France in 2 yeares 3770 tuns (?). The wines 21000 tuns (?) & the value of French Wines ——.

71. The Tobacco imported into London from the plantations —— and into all other parts of England & Ireland ——.

72. The Currants brought into England ——.

[1] *Cf.* No. 63 *supra*.

[2] This and the blanks which follow are as in the MS.

73. The Charge of the Dutch War anno 1665, 66 & 67 was about 4 millions.

74. The subsidy of 12*d*. per tun anno 1671 amounted to ——.

75. The postage of Letters hath improved in 30 years from 3000£ per annum to £30,000. The number of posting Coaches from 40 to 400.

76. The Land Carriage of goods to & from London comes to about £100,000 per annum.

77. Iron imported to England per annum about 4000 tuns.

79.[1] Wooll imported out of Ireland is about 5 millions of pounds, worth about £130,000.

80. In the Barbadoes [there are] 6 Blacks & Slaves to one White & freeman.

81. There belong to the 7 provinces[2] of fishing busses & dozzills[3] about 5000, of about 70 tuns each, and worth about 600£ each.

82. The Housing of all the Turkish Empire did not cost more days labour [in] the building, then those in the Kingdome of France.

83. There can be no profit [in] slaves in such countryes where a man can earne little more then hee himself spends; but the contrary in East India &c, where a man's victualls &c costs but $\frac{1}{10}$ of what his work will be fit for abroad.

84. The wages of workmen hath risen in England for late yeares, and the prices of Corne & Cattle have stood or fallen. Wherefor if $\frac{1}{3}$ sheaf bee equall to the rent of land, when wages rise $\frac{1}{8}$ Land must fall $\frac{1}{4}$.[4]

85. Gold & silver seemes the standard & measure of power of all comodityes in Europe, [tho] but one of

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[1] There is no observation No. 78.

[2] *I.e.*, the United Provinces of Holland.

[3] The 'buss' was a two- or three-masted vessel used for herring fishery. I cannot identify the 'dozzil.'

[4] Petty assumes elsewhere (*Political Arithmetic*, Hull, 274) that when the price of corn falls, wages will rise. It seems to be by parity of reasoning that he calculates that in the same circumstances the price of land will fall.

them (viz: silver) can bee it. But silver itselfe rises and falls not onely upon difference of Time & place upon Exchange and Interest, but also in itselfe: viz: as workmen have more or lesse reason to bestow labour more or lesse upon it.

86. Lands in Ireland are worth as many pounds rent per annum as there are eaters in it, and in England about $\frac{1}{3}$ more; and encrease of eaters advances rent in both.

87. England and the South or Lowlands of Scotland, are abundantly able to feed all the inhabitants of England, Scotland & Ireland, without peopling them thicker then the 7 United Provinces.

88. The perfect and naturall Union of the 3 Kingdomes of England, Ireland, & Scotland, is when the same proportion of each nation lives in all & every of the 3, as each of them beares to the whole: *e.g.*: If the Irish bee $\frac{1}{9}$ and the Scotch $\frac{1}{8}$ of all the King's subjects in the 3 nations, then that $\frac{1}{9}$ everywhere should bee Irish and $\frac{1}{8}$ Scotch in all and every of the 3. For Union in this case is but [a] proportionable & uniforme mixture. Other unions are but verball and nominall. The like may be said of different factions & religions.

89. The number of Temporal Lords in England is ——, of baronets & Knights ——.

90. One fifth part of the lands of England are actually under tillage for corne & hemp & flax. The rest is pasture, meadow, woods or unprofitable.

91. About 13£ per annum maintayns a foot soldier. 3 foot [are of] equal charge to one horse; and one horse and one foot [are equal] to one man at Sea in a K[ings] ship of Warre.

92. The value of mankind now and in England is about 70£ per head, one with another. In other countryes more or lesse, but the value of his superlucration (above his being) is far lesse.

93. There bee more males then females in nature. Besides a man is prolificq 40 yeares, a woman but

25 or thereabouts; which compensates the losse of men by the Sea, War, Exercises &c.

94. Mankind with[out] plagues doubles by generation in —— yeares; but allowing for such and so frequent plagues as are observed in England (where it takes $\frac{1}{5}$), they double but in —— yeares.[1]

95. The price of house-building in London of 3 storyes, cellar and garett, is from 35£ to 50£ per 100 feet square, and the poorest building upon one ground floore is about 5 sh. per foot, or as about 25 sh. per square of 5 floores[2]—So as the difference is as 30 to 1. Between which proportions there may be buildings of any rate, suitable to the use and Trade of the place.

96. That of about 200 birthes, but one woman dyes in Childbed.

97. Equall & like vessells at sea, *caeteris paribus* and in equall tymes, goe forward in proportion to the sizes of sayle they spread; *e.g.*, if one spread 49 yards of canvas and the other 25, they goe as 7 to 5.

98. If 2 vessells like bee built equally strong, theyre materialls must bee in quadrate proportion of their proportionable sides.

99. Let there bee 3 square bars of Timber, whereof let one bee supported at each end. If one of them alone will bear 100 pounds weight without cracking, 2 layd upon each other will beare 400 pounds, and 3 will beare 900 pounds.

100. In pilchard fishing 40 hogshead of fish make a saving voyage in the west of Ireland.

101. A young beast in 2 akers of good pasture encreases 100 or 120 ℔s. per annum in his weight, but a man encreases but about 8 ℔ per annum to 21. About 13 men weigh a ton.

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[1] Petty was always troubled in his search for this figure. In the Observations on the London Bills it is given as 200 years, in the Essay on the Growth of London 360, but in No. 93 *supra* it falls to 25 years!

[2] *Sic*, but is not 'feet' intended? I am, however, quite unable to interpret Petty's building estimates.

102. A pound of wheat will make the like weight of finished (?) bread, and 1 ℔ of malt will make a pint of strong beere.

103. In Ireland the hyde is $\frac{2}{3}$ the worth of the flesh, weight for weight, and the flesh $\frac{1}{3}$ of the Tallow; Hydes and tallow $\frac{2}{3}$ of the whole beast.

104. The manufacture bestowed upon all the foods exported out of Ireland in one year, is scarce worth 20,000£: viz: making freeze and stockings, pipe staves, pickling and casking of fish & beefe, making of butter & cheese (above the milk &c).

105. The manufactures of wooll exported yearly out of England (above the wool) are worth ——.

106. A Load of Timber builds a ton of shipping under 300 tun, and 20*s*. for Labour and workmanship of the said Timber, and 3£ the hull, sets forth the ship on merchants account.

107. A Tree (?) of Wood or Timber weighs about —— hundredweight.

108. If a horse, that can carry 400 weight, can with that weight travell 2½ miles per hower, hee shall with halfe that weight travell 3½ with like ease, and with 100 weight 4¾ [miles].

109. The best small money for farthings, halfe pence &c is to bee made of silver & iron ad valorem.

110. If the worth of the excise or expence of beere and ale bears proportions to the number of smokes, Then if every part of England did pay as London, Middlesex & Surrey doe pay, the whole would bee —— per annum; whereas tis let at ——. If all paid as —— then ——. If as —— then ——.

111. If land bee worth more or lesse according to the people, and if the people may be estimated by the smokes, Then . . .[1]

112. If computation were made what lands have been sold since His Majesty's restoration, and to what value; and of how much lands or money the purchasers have been deceyved by bad Titles; from

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[1] A portion of the MS. is here wanting.

thence & the charges of setting up secure Registers, may be deduced whether the design would bee of profit or not to the Comonwealth.

113. In Ireland hath been an act for Naturalising strangers on very easy termes. If it were enquired how many have been naturalized upon it, and to what advantage of the Comonwealth, it would bee seen whether such acts alone bee sufficient to bring in Strangers to encrease the people—as I feare it is not.

114. The naturall measures of mulcts on heterodox professions, is the charge of so much force as will keep the peace; to bee applotted upon each person and party according to his effect & power to disturb the publicq quiett. From whence may also bee deduced a way to discerne between heterodox beleivers, and bare professors, and interested pretenders only.

115. To ballance the importance of forraigne comodityes wee give: (1) The Manufactures of wooll. (2) Lead, Iron, Coales, Hydes & tallow. (3) The Exportation of many comodityes Imported, some manufactured by us & some not. (4) The proceed of the plantations and East India Trades. (5) The freight of the shipping. (6) So much of exported Irish Comoditys as belong to Inhabitants of England. If the value of all these exceed that of Importations wee thrive, otherwise not.

116. The value of such goods imported yearely into England, is about one million, & into all other parts about 3 millions. In all fower millions.

117. The value of goods exported out of England & Ireland seeme in each Kingdome equall to the rent of Lands, which the Landlord receyving payes away for forraigne Comodityes imported in exch[ange] of superfluities exported; and the Nation of England gaynes by Trade the value of what is imported and exported againe.

118. In England the power of compelling men's persons to serve in War, and of raising money to maintain them, lyes in 2 severall hands.

119. Churches, where Tythes are impropriate, are servd with Curates for about 30£ per annum. If that bee enough, why have other men? If the appropriate Tythes bee [not] enough why is not more allowed? Aequality would bee better.

120. Cathedrall Churches, Universities, Colledges, Hospitalls, Companys of Tradesmen, Cittyes & Corporations are governd for the most part by aristocracy or democracy, and that upon annuall Rotation; though all bee done by Monarchical Commission & leave.

121. A ship of war is to bee estimated greater or lesser by the area of her gun deck, the ports being 3½ feet above the water.

122. The Reason of the Dutche carrying far less freight then others is: (1) That they are undersayld, masts, yarded &c, but chiefly (2) That the multiplying of their Trade allowes a particular build, discipline, and oeconomy for each Trade & (3) That few are exempt from handy worke.

123. The expence of [a] family in fuell, Candle, & washing shew best the nature & measure of its expence and oeconomy.

124. The Table of great men is but ⅓ of their expence, but of artisans & laborers tis above ⅔ of the whole.

125. The ⅓ of the price of a usuall (?) London house [to Turnkey &c] is to bee expended in the first yeares of its being dwelt in.

126. A man of estate ought in England to build an house [out] of above 1½ years revenue (In Ireland but of one) and to bestow ⅔ in the furniture.

127. Tis no Calamity or Extremity to Retrench $\frac{1}{20}$th of the quantity of his food; lesse if it be done in quality. Nor is it a greater calamity but [to] bestow $\frac{1}{20}$th more in labour.

128. The farmer of England doth usually sell the proceed of his farme for thrice his rent; and if by all other Trades usufruct (?) is gotten but by husbandry

alone, It followes that the expence of the people is 5 times the rent of the Land, as hath elsewhere been estimated.

129. The Inconvenience of taxing lands, and not goods & persons, is intollerable—and vice versa.

130. The dioceses, parishes, shires of England are Unequall, & the Elections to Parliament are Unequall.

131. Gaming is onely losse of time, and an encouragement to men of good talents to bestow them beside the publicq good.

132. If all verdicts & sentences had been quite contrary to what they are, the Wealth of the Nation would seeme to bee the same; otherwise then that Injustice and uncertainty of enjoying what a man gets, is a discouragment to Industry, & so a cause of comon poverty.

133. Judges that take bribes will take of both, and the Crafty will refund to the looser. This also is an evil of the nature last mentioned.

134. The value of what is exported out of England is about 3 million, out of Scotland & Ireland 1½ million. The freight of shipping 1¼ million. The proceed of the East & West India Trade 2 million. In all about 8 million. The Importations about 7 million, & the value of so much thereof as is exported againe 1 million. So as the gayne of the Nation is 2 million.

135. There were massacred in Ireland in the first yeare of the Tumultuary rebellion, and starved with hunger & cold, not (as some have said) 154,000; but about 45,000, men women & children. There were killed in the 12 years wars, starved and dyed of languor[1] diseases 72,000. There [were] sent away by Cromwell (more then returned after 1654) 28000. In all 145,000 men; besides men, women, & children that dyed of the plague and famine which may be attributed to the said war, by estimate —— thousand.

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[1] The word seems to signify ordinary diseases as opposed to plague and famine.

There were in armes of all sides in Ireland for the 12 yeares of the said warres 100,000 men. Extra forces from 53 to 63 at least 6000. The value of houses burnt, goods spoyled, emprovements destroyed 300,000. The destruction of the Stock, Cattle, and Trade of the nation, and the cessation thereof for 15 yeares. N.B. So much as Ireland is emprovd from 1655 to 1671, so much it lost from 1640 to 1655.

136. If there bee 6 millions of people in England, 2 of them are children, males & females, under 7 yeares old.

2 millions more are women, whereof but ¼ work at baking, brewing, cooking, gardening, the dairy, sempstry, spinning, knitting, lace making, winnowing &c, and are equivalent to 500,000 adult workmen.

2 million more are males, whereof ¼ are boyes between 7 & 17 yeares, whereof above 100,000 needlessly loose their tymes in learning lattine & greeke. The rest are equivalent to half the said number or 500,000 workmen.

Of the other million of males, 30,000 are Divines, Physicians, Lawyers, & soldiers in armes. 100,000 are Landed men. 60,000 are foraigne merchants, wholesale inland merchants, & retaylers. 100,000 are M . . . (?) artisans, & 10,000 are gamesters, cheates, Thieves, mercenary whores-bawds, beggars by Trade, & Impotents; and 700,000 are Seamen, husbandmen, handicraftsmen & laborers.

So as that the whole stresse lyes upon the equivalent of about 1,800,000 Laborermen,[1] who perhaps at a medium may consume 20£ per annum one with another, [or] between 4*s*. and 12*s*. per week; in all 36,000,000£. Which, with about 8 millions of rent of lands, 7 millions as the proceed of the stock of the nation, makes above 51 millions in all; to answer the expence of about £8 per head, one with another.

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[1] This figure seems to be obtained by adding together the 500,000 women, 500,000 boys, 100,000 artizans, and 700,000 labourers *ut supra.*

(Of the Truth of all which conjectures I have no other certainty, but that the severall suppositions are possible and do well enough solve the phoenomena.)

137. By Landed men I understand such as have interest either in the fee, reversions, remainder, or by mortgage, beneficiall lease &c.

Of [the] 30,000: Divines [are] 12,000, Lawyers 3500, Physicians 1500, soldiers the rest, viz, 13,000.

Of [the] 60000, merchants [are] 1000, wholesale men 9000, Retaylers The rest, viz, 50,000.

(Memorandum. That these estimates are made upon computations of parishes, Cathedralls, the Inns of Court & Chancery, Doctors Comons, the Universitys, Colledge of Physicians, The Exchanges of London, Dublin, and Bristoll, the freeholders appearing at assizes.)

Of 700,000 artizans, 250,000 [are] husbandmen, 150,000 relate to the manufacture of wooll, 160,000 to Building, 40,000 seamen, 50,000 to Trades of pleasure & ornament, & 50,000 servants to gentlemen.

Of 6 millions there [are] but 1 million of males aged between 16 and 60, and of workmen, as hath been sayd, but 800,000.

Of men fit as well as able for war in case of greatest Extremity not above 600,000; but of these no more can be employd then can bee fed & mayntaynd by the Labour of the rest, which depends upon the governors, wealth and policy of the country.

Wherefore if there bee in England but the equivalent of 1,800,000 workmen and Laborers, and that they can earne but for 300,000 (besides themselves and the rest of the 6 millions), no more can bee soldiers. And so when the Invasion is greater than the greatest mentionable force can resist —— &c.

XXV

VERSES &c.

(149) Palinodia—(150) Ode to Maecenas—(151) A Naval Allegory—(152) In doctorem Titum Oates—(153) Religious—(154) Profane—(155) Votum senescentis—(156) Upon Sir William Petty's Bad Eyes—(157) Sir William Petty to his daughter Anne.

VERSES

WRITING of Petty in his famous diary, John Evelyn gave it as his opinion that " there was no better Latin poet living, when he gives himself that diversion." Petty himself apparently did not share this illusion, for when sending some of his verses to Southwell he says: " Why will you trouble yourself with them? I had indeed some pleasure in making them, but do not see why you should have any in reading them. They, as my other things, are crammed with a sort of dry matter and describe the truth of things, but they all want the very flame & spirit of poetry. So also do my other proceedings want the Poetry of Craft, Lying flattery, dissimulation, base complacency &c.—and therefore are unsuccessful " (*Corr.*, 29th September 1677).

A collection of Petty's unpublished writings would not, however, be complete without some of his metrical pieces, of which a whole volume under the title of " Poetical Amusements " have been preserved in MS. They are on every conceivable subject, in Latin and in English, and include verses on Political Arithmetic, on the Down Survey, on his Coat of Arms, on the making of Casks and Hobnails, and on the Sweetening of Sea Water, besides a biographical treatise of some 300 hexameters entitled " Vita W.P."

The first example printed below (*Palinodia*, No. 149) was written in 1637, when, as a boy of 14 working before the mast, Petty broke his leg, and was cast ashore on the coast of Normandy. Here, he tells us, he was " strangely visited by many by the name of ' Le Petit Matelot Anglais qui parle Latin et Grec ' " (*Corr.*, 14th July 1686). He turned his gift of tongues to good effect by addressing the Jesuit fathers of Caen in Latin verse, and thereby gained admittance to their college, where he seems to have remained for two years. The MSS. also contain an English version of the *Palinodia* written apparently some years later.

The translation of Horace's Ode to Maecenas (No. 150) was written, according to Petty's list, in 1665. I am unable to explain the meaning of the words ' p[er] Alex. Brown ' which occur in this entry (No. 158 *infra*), unless they constitute one more example of Petty's unwillingness to allow anything to go forth over his own name.

In 1677 Petty writes to Southwell: " Lord that a man of 54 years old should after 36 years discontinuance return to the making of verses which boys of 15 can correct " (*Corr.*, 3rd April 1677). The occasion of the above reflection was a translation of the 104th Psalm into Latin verse, composed for the most part while its author was in prison; for he was apprehended and confined for Contempt of Court in Dublin in 1677 (*Corr.*, 10th February 1677). The Psalm eventually (in 1679) found a publisher under the title *Colloquium Davidis cum anima sua, Fecit Cassid Aureus minutius.* It was the only one of Petty's poetical efforts to reach the printing press.

In the same year he produced the *Naval Allegory* (No. 151) in honour of the Duke of Ormond, who was then for the third time entering upon office as Lord Lieutenant of Ireland. From the *Correspondence* we learn that he sent a copy of these verses to Southwell, to be passed to Pepys, though he himself was ' afraid to show them, much less to print them ' (*Corr.*, 22nd August 1677). It is characteristic of the writer that he manages to work into his congratulatory ode a recital of his troubles with regard to Irish land, from a recurrence of which he hoped no doubt that the new Viceroy would save him.

No. 152, *In doctorem Titum Oates*, must have been written in 1678, soon after Oates had ' discovered ' the alleged Popish Plot, and before the discoverer had been himself exposed.

Nos. 153 and 154 are two fugitive pieces—commendable neither in manner nor in matter, but printed as examples of Petty's inveterate habit of versification on all subjects, sacred and profane. I have called them ' Religious ' and ' Rabelaisian.'

No. 155, *Votum senis*, is a Latin poem on old age, on which he must have expended some trouble, for there are four drafts or copies of it, as well as an English translation (apparently made for Sir Peter Pett) among the MSS.

About the same time he wrote another Latin poem in the same vein, which he entitles *Lamentatio—ad Gulielmum Pettaeum, oculis et artubus morbose captum et decumbentem.* This, we learn from the *Correspondence*, was sent to Southwell in July 1678. No. 156, *Upon Sir William Petty's Bad Eyes*, seems to have been written by way of reply to the above. It professes to be signed by one "Dorothy Arswacker," but the original bears corrections in Petty's hand, and I think there can be no doubt that this squib also emanated from his fertile brain.

Petty displays some prophetic instinct in No. 157, addressed to his daughter Anne in 1679. Anne was then aged six, and her father, as it seems, already hoped that she would marry an earl. She did (forty-five years later) become a countess, having become united some time after her father's death to the Lord Kerry of the day, who was eventually (in 1723) promoted to an earldom. 'My Anne' may have been a 'pretty pussling' at six years old, but she is referred to by her grandson, the first Marquis of Lansdowne (*Life of Lord Shelburne*, vol. i, p. 2) as "a very ugly woman"—a description which is amply confirmed by the only portrait of her now extant. Lord Shelburne, however, somewhat relieves the picture by adding that his grandmother "brought into his family whatever degree of sense may have appeared in it, and whatever wealth is likely to remain in it."

The care which Petty had bestowed on Anne's economic education thus received its posthumous reward, and he was justified in the hope he had once expressed to Southwell (*Corr.*, 4th December 1684) "that Arithmetic & accountancy will one day adorn a young woman better than a suit of ribbands, and keep her warmer than a damnable dear manto."

No. 149

PALINODIA

Ad Patres Soc. Jesu. Cadomaeos.[1] *G. P. Anglus*

Ille Ego Neglectus qui patria rura colebam
Atque Scholas, Puerum steriles ubi jungere voces
Flagra coercebant, ubi Tempora verba modoque
Totus eram, et variare cadentia nomina rerum

Postea permultum et temere mutatus ab illo
Me pelago ratibusque dedi, conscendere malos

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[1] Cadomus was the Latin name for Caen.

Vela pluare, gravem et iorcum gyrare rudentem
Tunc maris et venti motum, tunc astra notare
Addidici, Remos et gubernacula (Navis
Trames ut exigerit) tractare, et dicere rhombis
Nostrates Dracos, heu sic miratus abivi
Nauta scholas fugiens et dulcia carmina sprevi.

At nunc quem claudum mala nautica turba reliquit
Littera vestra super, Tam crura effracta valescens
Pertae fusque maris, Patres, vos supplico musas
Iratas (pro me) laesas et Apollinis aras
Orare, ut sacris fueram qui transfuga castris
Denuo musarum accipiar redamatus alumnus.

Prima Geographicam doceat me classis, ut acres
Rhetorflectam animos, Heroem ut carmine pingam
Chronologus vobis antique docentibus anni
Et genera et metas discam, Quo tempore regnum
Quodlibet et stetit ceciditque, Historicus ul sim
Tum Logicam docear, purae rationis et usum
Denique naturae videam penetralia sacrae.

Sic ego qui claudus diffracto crure jacebam
Laetabor, patero cum alata mente volare
Naviculamque tulit quae me Cadomensium ad oras
Laudabo, ut quae me tulit hac in Lumina matrem.
Sinite cum tortico Zizania cresure, siqua
Forsitan Angliaca sub religione laterent
Quae velit, vellat Deus ipse, in messe futura suapte.

(*Endorsed.* "Anno 1637. Guil. Petty Rumseensis, Angli. Ad Patres Soc. Jesu Cadomœos. Palinodia.")

No. 150

Horace. Ode I(a)

Maecenas, Bough of Royall Tree,
Honour, food, shade & fence to mee!

Mankind's great masse more sorts doth yeeld
Of minds, then doth of herbs the field.
For some you see delight to try
What Bird his fellowes can outfly—
What Boate another wrongs—what hound
Or horse most nimbly rids the ground.
And's pleasd to see what's lost & won,
And bee concernd with those that run.
Another's ravisht when Lowd votes,
Bellowd with zeale from popular Throates,
Cry'm up ' Burghesse,' or the Shires Knight,
As tho' stiff Patron of their Right.
For Wagers nor Election strives
The Third, But when he plumps & thrives
Is onely glad; when Tradeings quick,
When gayn comes in threefold & thick.
Neither of those to change their State
With Kings would think't a better fate.
Merchants when they have lately Lost
When ships are wrackt, or marketts Crost
Sometime foresweare the Sea in hast,
Yet streight will try t'other Cast.
And let next Chance prove what it will,
Merchants will bee Merchants still.
To Seiges and Campagnes some
With Trumpett tickld & sound of Drum.
Aboard the Fleet do also run,
To fight, at least to see what's don.
Others abhorring Camps and Forts
Rather delight in Country Sports,
To fish to shoote to hunt to hawke,
Of what they've hit and mist to talke.
But as for mee, my Pleasure lyes
In seeing how my Fancy flyes,
How by my songs & Tunes I charme
The Court, the Citty, & the Farme.
For in this Orbe mee thinks I shine
Not Candle like, but Star Divine.

No. 151

A NAVALL ALLEGORY

By the Register of the Admiralty of Ireland; To His Grace James Duke of Ormond as Grand Pilot of the good ship Ireland, upon his fourth expedition on that Bottome.

What weather are we like to have? of what
Long voyage are we going? that you're at
The Helme this fourth time now, and take in hand
The whipstaffe of the sword and Chiefe Command.
  When first you took't, Boreas Rebellion blew
An Ulster stress of wind which overthrew
Both Church and State, untill you sail'd close hall'd
Into the smoothings a cessation call'd.
  Next turne you took at Ireland's ticklish Helm
Was when the Pope and Nuncio Plagu'd the Relm
With spirituall Frauds, and Bugbear fulmination
And when Rump reign'd in carnall usurpation.
Then did you wisely lash the Helm a Lee
And put the Ship atry, till you could see
What saile to make, you spoon'd away before
The wind and sea, untill the storm was ore.
Without a knot of sail you drove twelve yeares
Tost with the floods of hope, and ebbs of Feares.
Soe driven about with Tydes and Currents motion
And having crost a wide Atlantic Ocean
You made the coast of Ireland, and then once more
You took the Helm, and bore in with the shore.
A noble Pilotage! for tho the weather
Seem'd fair (the King restor'd) yet you had neither
Compass, nor card, nor running glass, nor line
Yett stood the coars your wisdome did Divine
Amids a thousand Rocks. Here lay a Sand
of *Souldiers interests* [1] (Some in Command,

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[1] An explanation of most of the technical terms here mentioned in connection with the Cromwellian settlement will be found in No. 18 *supra*.

Some out); there ran a dangerous shelfe
Of vexd *Adventurers* and men of Pelfe.
Here a strong Tyde of *Innocents* sett in
Which spoyled the fishing, *Nocents* were soe thinn.
There *Conought Purchasers* and *Transplantees*
Meeting a thousand sorts of bold *grantees*,
Made a grown Sea. Here come a hasty fog
of dark *Provisoes*, which the Acts did clog.
There arose clouds of severall sorts of men
(Whose names I cant remember, one in tenn)
Ensigne, Meromotu, men Reprisable,
Nominees, and such as never yett were able
To sett their foot on Land. All made a noyse
Like sheet flown sayles, the Court claim-swearing boyes
With Paraphrasd oaths, steeld with pretence of clause
In *Act Explanatory* and other Laws,
Begot a damned confusion, fore and aft.
Whilst some rejoyct, some fum'd, some cryd, some
laught,
Sometimes a flow of wind (or angry vote
of Parliament) would oversett the Boate.
All this while you (I mean great Ormond you)
Stood right in with the Land, kept the ship to
The King and Countrie Interest; and when a Puffe
Of other wind did blow, you kept your luffe
And got to windward. Thus we all (tho late)
Came to an anchor in *Certificate*,
Where having stopt on Tyde at length we went
All safe on th' shore of *Letters* call'd *Patent*.
Some of the Fleet stayd in the Bay *Decree*,
Some hull'd in th' open shore of *Letterree*.
Thus landed all the freight of Acreage paid
Yeares value, subsidy and *chymny-aid*.
We went to sleep till the Exchequer Bees
Woke us again, and stung us with their Fees
And wild demands. "Oh King! is't your Intent
(After these scapes) the Hurricane *Quitt rent*
Should stave and sink's? Or that a Locust swarme
Of Pilfring Picaroons should do us harme?"

"Noe (quoth the King) I'le sooner make James goe
A fourth trip more for Ireland." "Let it be soe!"
Cryd one and all. Thus did with cheerful voyce
The whole ship's crew from stem to sterne rejoyce.

The Postscript

The greater was their Joy; because they all
Hop'd Ossory (their Friend, Father, Admirall,—
Ossory the Great, the Honest, and the Stout)
Might by this meanes at Helm have t'other bout
"Were he" (quoth they) "but Boatswain, all were well.
Hee'd not the cables nor the anchors sell,
Make stayes nor shrowds of Rotten Ropes, nor lett
Harld Kenks into the running Rigging gett.
All sheeves should in their Blocks run yare and clever,
Capstans gyre true, the Pumps of Justice never
Bee at fault, but allways fitt the Hold, to free
From what can dangerous or noysome bee."
Ormond and Ossory dont sail for wages,
They have great cargoes of their owne, and gages
For Ireland's common interest still to be true,
And make the High pay to the Low their due.

Let's drink their Healths! Here's to 'em, my hearts of gold!
Ossory bee young and Ormond never old!

No. 152

In Doctorem Titum Otes

Et Jesuitus laqueo confectos

Arcum Dola dedit Patribus, dedit alma sagittam
Gallia; quis funem quem meruere, dabit?
Quis dabit rem rogitus? quis funem Patribus? Ecce
Otes illis funem quem meruere, dedit.

Godfredus (dubitus?) proprio non ense cadebat
  Ensibus at proprus, Heu, cecidere Patres.
Fistula dulce canit, si sic cecinisset Aveno
  Nulla piis patribus crux onerata foret
Nunc queruli dicunt; Steriles dominantur Avenae
  Quas tamen aut falx, aut Sulphura nostra metent.
Christicolis primis sedebat Episcopus olim
  Titus, Tu Tito es Titior Angligenis.
Cum lupos laqueo strinxisti Tite voraces,
  Cur non fis saltem, miror, Episcopulus?
O utinam quos tu ceu lupos fune premebas
  Praesulibus queisdam, non habeantur oves.

(*Endorsed.* "In Otem et Jesuitos.")

No. 153

[Religious]

God is, and Jesus is his son,
The Ghost's from both. All 3 are one.
Religion's Naturall, and good
For King or State, if understood;
If not, t'is but a meere illusion,
Begetting bloodshed and confusion.

Religion must be full of mysteries
Grounded on old hallowed hystories,
Visions and dreams of holy men,
On ghosts of dead folk risen agen,
The words of those who are assured, (?)
And facts by multitudes insurd.
All this while Adam and Noë,
Abraham, Moses and Jesus too
Obedience is taught a way (?)
Then sacrifice every day,
That those who seek God shall him find
And that his works declare his mind,

And that to do as we would have
Others do to's, our souls will save.
And lastly that to this above intent
The holy men of old were sent,
And not to do as some who've made
Of religion a filthy trade.
Do well therfore, and every hower
Be subject to the Higher Power.

No. 154

[RABELAISIAN]

Hic narrata Venus, formas hic foemina dicet
Queis petuit, coitumquae viro sat seria monstrat
Sic lubet exuctos cunnum ad revocare priapos
Quolibet inde habeat quatuor sibi vulvula denso
Queis bis terve die se frictam caret et moretam
Rilibus et veneris modice satiata quiescat
Nam sine pene quies non est Mulieribus ulla
Dum fretae ad libitum quatuor dormire necesse est fuit forte quietae.

No. 155

VOTUM SENESCENTIS

Cum calvum me aspiciam canis albescere
Minus perspicacem, rarius tumescere
Duxi tempestivum hoc fecisse notum
Quod vellem bonis omnibus esse notum—
  Ut senior melior choleras et biles
  Regam dum sensim deterat seniles
    Mors mihi vires.

Salubri in oppidulo dant mihi fata domum
Cum saxo scala ad fores, hortum quo pomum

Crescat, olus et legumen, herba, ac flores.
Et quidquid faciat feros et amores—
  Ut senior melior &c,

Stet domus ad ripam rivuli murmurantis,
Nec non in conspectu sinus aestuaribis
Mari intersit, rivuloque, ager gratus
Planus virescens, mille passus latus—
  Ut senior melior &c,

Equalum conscendam ex illo graduato
Saxo pro feribus, aequali, ac lato
Dulces hauriam in campo aeris effectus
Illo solutante versperi subvectus—
  Ut senior melior &c,

Habeat mea domus lepidam, quae licet
Uxor non fuerit calvum me fricet
Faciat reminisci, mobilique manu
Obeat quae piget fieri ab anu—
  Ut senior melior &c,

Habeat mea mensa Dominicis diebus
Pudding confectum ex his bene rebus,
Pollento, lacte, aromate et ovis
Uvis Corynthiacis atque adipse bovis—
  Ut senior melior &c,

Habeat et carnes bibulas et ovillas
Ferinas interdum (namque amo et illas)
Habeat ab horto recens acetarva
Anni pro tempore grata et varia,
  Ut senior melior &c,

Digitos et ora linseis abstergamus
Rosam spirantibus, herbasque quas amamus
Habeant et lecti similes odores
Quos dent nostratia semina et flores.
  Ut senior melior &c,

Rideant in poculis potus repetitae
Quos Cereres fecerit plenos aqua vitae

Habeam et Falernum quo festivi in regis
Bibamus salutem et tutamen legis.
  Ut senior melior &c,

Ne volitet nimium parochus commensalis
Habeam et Latinula quae appendam alis
Gaudeam poetarum veterum libellis
Qui multum capiant salis et mallis.
  Ut senior melior &c,

Absit mihi calculus, rodens et arthritis,
Immanis hydrops, colica et imitis;
Nec turbe foeda palmo putreat mobilis
Arx apoplexia, nec decumbet nobilis.
  Ut senior melior &c,

Denique sic vivam ut de mortuo sodalis
Dicat, omnis, non superest illi alter talis
Nam mane agebat sobria facetus
Vesperi ebriola risisicus et laetus.
  Nam senior melior choleras et biles
  Rexit dum sensim deterit senilis
    Mors illi vires.

No. 156

Upon Sir Wm. Petty's Badd Eyes

Petty complains that nature was unkinde
In that she made him Heavy eyed and Blinde,
Never considering that the mighty Three
Fortune, Love, Justice, were more blinde than Hee,
Nor that Prospective eyed Prometheus might
For all his Fortune blame alone his sight.
Sight gnaw'd his Bowells, nor could his Provident minde
Rest untill the night and sleep had made him Blinde.
Temples are dark, seraphic contemplations
Are best perform'd in gloomy convocations.

The Blinde were all his friends, for understand
It was Blinde fortune gave him all his land,
Blinde love (in her he had) gave him a wife
Rich faire and civil, without fraud or strife;
When Justice was quite Blinde, no man o' law
Could hurt his rights. He conquer'd Ramataw
But when the unmuffled Jade peep'd out to spy
Envys and Interests, then all the world letts Fly
Their Tongues and Teeth. It hayled subpoenas, and
It thundered greenwax against all his land.
Justice (look to't) be old and blind agen
That Petty may be used like other men!
Oh Love put out thy fires! Oh Fortune lett
Thy tottering wheeles no glimpse of eyesight gett!
The world will then be govern'd well enough
When Courts and States all Play at Blind man buffe.

p. DOROTHY ARSWACKER.

No. 157

SIR WM. PETTY TO HIS DAUGHTER ANNE

March 1678-9

My pretty little Pusling and my daughter An
That shall bee a countesse, if her pappa can.
If her pappa cannot, then I make no doubt
But my little Pusling will bee content without.
If my little Pusling prove an ugly carron,
Then it will bee well enough
If she gett but a barron.
But if her fortune should bee so
as to get but a Knight,
Then I trow her cake is dough
And hopes are all beshite.

XXVI

LISTS OF WRITINGS

(158) A Collection of W. Petty's several works and writings (1636-1671)—(159) Catalogue of Essays 1685—(160) Catalogus Scriptorum 1686—(161) A List of Subjects.

LISTS OF WRITINGS

I HAVE printed in this chapter four lists of Petty's works and writings, the originals of all of which are in his own hand.

To the first of these (No. 158) I have frequently had occasion to refer in the preceding pages. As a biographical document the list possesses considerable importance, for it gives the clue to the literary activities of Petty's earlier years, concerning which we have no other source of information.

This list was printed in Petty's *Life* (Fitzmaurice, 317) and reprinted by Hull (p. 653). The MS. used was, however, not the original one (which is amongst the Petty papers), but a copy transcribed a century later by Lord Shelburne, afterwards the first Marquis of Lansdowne (Fitzmaurice, Preface, 9). Lord Shelburne had made numerous mistakes in his transcription, while, by the omission of the date (1671) and the addition to the list of a work written in 1682, his copy gave the impression that the paper had been written at least eleven years later than was in fact the case. These mistakes are now rectified, and the major portion of the writings mentioned have been identified as still extant. Thus the entry, under date 1660, of "Observations on the Bills of Mortality" becomes (as I have emphasized *infra*, p. 275) an important piece of evidence in favour of Petty's authorship of that work as against Graunt's.

The second and third lists (Nos. 159 and 160) are dated respectively 1685 and 1686. These seem to have been with Petty years of astonishing mental activity. I have pointed out elsewhere (Introduction, xviii) that he was by this time incapable of much bodily exertion and was in a manner forced to give vent to his energies on paper. Here again many of the writings (but by no means all) can be identified, approximately at all events, with those which have been printed in the past or are now included in these volumes.

The list numbered 161 is more difficult to explain. It lacks both date and heading. Of the eighty-four subjects which it contains, many (perhaps most) were actually dealt with in some form or other by Petty during the course of his life, but it is impossible to believe that he can ever have found the time to write specifically upon them all, or that had he done so, so many papers would have totally disappeared.

I have therefore come to the conclusion that this paper is little more than a manifestation of Petty's passion—which must be apparent to all readers of his papers—for list making, and that it represents a catalogue of subjects to which he had given his thoughts. He may have hoped in time to write upon them all, and set them down perhaps as a guide to those who might wish to follow in his footsteps in the pursuit of Natural Philosophy.

It is impossible to 'equate' definitely Petty's published and unpublished writings with those mentioned below. In some cases it is evident that though the subject matter may be the same, the papers do not correspond in point of date to the documents cited in the lists. With this reservation I have inserted references as follows:

(*a*) To papers in the present volumes, which are given under their serial number.
(*b*) To those which had been previously printed—by their number in the short Bibliography on p. 285 *infra*, prefixed by the letter B.
(*c*) To such as I have identified amongst the unprinted MSS. by an asterisk.

No. 158

6 *Octob.* 1671. A Collection of W. Petty's Severall Works and Writings since the Yeare 1636

	Anno	
Caen	1637	A Course of practicall Geometry and dialling.
	1638	*Cursus Rhetorices et Geographiae.*
London	1639	A Systeme of Astronomy (Ptolemaical, Copernican).
	1640	Severall drawings and paintings.
	1643	An English Poem of Susanna and the Elders.

Holland (lost at sea)	1644	*Collegium Logicum et Metaphysicum.*
		A Collection of the Frugalities of Holland. [No. 132.]
	1645	An history of 7 monthes practise in a Chymicall Laboratory.
Paris Oxford	1646	A discourse in Latin *De Arthritide et Lue Venerea*[*] and *Cursus anatomicus.* [*]
London	1647	Advice to Mr. Hartlib about the advancment of Learning. [B. 3.]
		Collections for the history of Trade &c. [Nos. 60, 61, 62.]
	1648	The Double Writing Instrument. [B. 1.] The engine for planting Corne.
		Printing—Boyling water in wood.
Oxford	1649	Six Physico Medicall Lectures, read at Oxford. [*]
London	1650	Severall Musick Lectures. History [of] An Greene. [No. 126.]
	1651	Collection of Experiments—3 osteologicall lectures. [*]
	1652	*Pharmacopoea* and *formulae Medicamentorum.* [*]
		Observationes Medicae et Praxis. [No. 147.]
Ireland	1653	*De Plantis.* [*] *Notae in Hippocratem. Scholaris scholifuga, Poema latina.*[1]
	1654	A discourse against the Transplantation into Connaught.

A treatise of Irregular Dialls.
1655 The Grand Survey of Ireland.
1656 Severall reports about settling the Adventurers and Soldiers.
1657 Bookes, as Clerk of the Councill.

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[1] Of the student who forsook his studies, *i.e.*, of Petty himself when he gave up medicine for land surveying in Ireland.

1658	Letters &c between the Protector and the Ch. Govr. of Ireland.
1659	The History of the Survey and first distribution of Landes in Ireland. [B. 31.]
	Booke against Sankey; and W.P. his owne Apology. [B. 4.]
1660	Observations on the Bills of Mortality.
1661	Discourses about a Registry and settlemt. of Ireland. [No. 25.]
1662	Treatise of Taxes. [Hull, vol. ii.] Materialls for a Bill and small mony.
1663	The Grand Map of Ireland and books of barronyes. [B. 34.]
	The Naturall history of Religion. History of Clothing. History of Dying. [B. 7.] Satyricall Poems.
1664	Navall experiments and discourses. [*] *De motu maris et ventorum.*
	De Missilibus per aquam et aeram. Naviles gemina.
	Rationarum Nauticorum. Anatomia Navalis.[1]
1665	*Verbum Sapienti* and the Value of people. [B. 24.]
	English Translation of Horace, per Alex. Browne. [No. 150.]
1667	Lawsuits.
1668	*Poema Glanarota.*[2] [*]
1669	Severall latin Epigrams. [*]
1670	*Anatomia Politica Hiberniae.* [B. 24.]
1671	Politicall Arithmetick. [B. 23.]

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[1] In a letter of 25th February 1663 Petty speaks of papers written by him: *De motu ventorum et maris; De missilibus per aquam aërem et utrumque medium; De navium varietate usu et cura; De navi volante.*

[2] *I.e.*, verses about Glenarought, the barony in county Kerry, in which most of Petty's property was situated.

No. 159

Catalogue of Essayes: 1685

1. Upon the Births, Burialls, and Marriages.
2. The Value of Jewells. [? *A Dialogue of Diamonds.* Hull, 624 foll.]
3. Of Bankrupts and Stewards. [No. 70.]
4. Beggars, Thieves and Prisons.
5. Preaching (?) by Postage and Printing.
6. Fluctuating Oligarchy.
7. Transmutation of Irish into English. [No. 21.]
8. Politicall Arithmetic; in 6 Essayes. [B. 23.]
9. Growth of the People and Multiplication of Mankind. [B. 17.]
10. Growth of London. [B. 19.]
11. Navall Philosophy. [B. 25.]
12. System of Navall Experiments. [*]
13. Of Land Carriages. [B. 14.]
14. Of New Guns and Artillery.
15. Chariots of War. [Nos. 99, 100.]
16. Of Pumps and Water Engines. [Nos. 119, 120.]
17. Scale of Salubrity.
18. System of the World.
19. Affinity of Creatures. [No. 87.]
20. The Comon Fabric and Generation of Animals.
21. The Many Wayes of Worshipping God. [Nos. 36, 37, 38.]
22. Method of Reading the Scriptures. [No. 39.]
23. The Measures of Forain Commerce.
24. History of Trades. [No. 60.]
25. Vulgar Phaenomena in Nature. [*Cf.* No. 147.]
26. Valuation of Peoples, Lands, and Goods. [No. 49.]
27. Supellex Philosophica.
28. Analysis of Houses, Ships, Coaches. [No. 52.]
29. Of a Common Council. [Nos. 4, 5.]
30. Parliament of the Empire. [No. 8.]
31. Double Trade.

32. Bounding the Sea, and Altum Mare. [No. 65.]
33. The Art of Medicine. [No. 128.]
34. Food and Rayment.
35. Jersy and Guernsey.
36. Reall Dictionary. [Nos. 46, 47.]
37. Of Ridicule. [No. 136.]
38. The Practice of the Law. [No. 135.]
39. Of an Equall Tax.
40. The Measures of Shipping, Horse, Foot, and Dragoons for an Island.
41. Of the Measures of Severall Matters. [No. 90.]
42. Of Wine, Women, Music, Painting, and Poetry.
43. A Mold of Wooll, with Fortifications and Attaques by the same. [Nos. 101 to 104.]
44. A Bank, upon London Ground Rents.
45. Of the Greek and Lattine Tongues, P. Hic et Nunc.
46. Of Gold and Silver, Mony, Interest, Exchange and the Banker's Trade.
47. Church Revenues. [No. 44.]
48. Scavenger and Paving Highwayes, Havens, Bridges.
49. Of Whores, Concubines, Restricted (?) Marriages, Eunucks, Polygamy, Caelibat by Obligation.
50. Of Prelacy, Papacy, Presbytery, Independency, Liberty of Conscience. [Nos. 42, 43.]

(*Endorsed.* "A Catalogue of Essayes. 1685.")

No. 160

CATALOGUS SCRIPTORUM 1686

Designs of Profit

1. Building on the Garden in Piccadilly.
2. Building at Rumsey.
3. The Bridge at Lambeth. [No. 71.]
4. Deforestation. [Nos. 116, 117.]

5. Bedzebury, Marbury, Pathcham.[1]
6. Pensylvania. [No. 110, 111, 112.]
7. Brick Work and Lowboro.
8. Irish Colony.
9. Transplantation of 100^{m} Families. [Nos. 20 to 23.]
10. About the Valuation of Land.

Engines

1. The Portguard Ship.
2. The War Chariott. [Nos. 99, 100.]
3. The Ballaste Boate.
4. The Severall Sorts of Pumps. [Nos. 119, 120.]

Workes

1. Finished the History of the Survey. [B. 31.]
2. The Legend.
3. Narrative of Christianity. [No. 45.]
4. Explication of 12 Theologicall Words. [No. 48.]
5. Explication of Many other Words. [No. 47.]
6. A Dictionary of Sense. [No. 46.]

About Ireland

1. Answer to the Narrative of the Settlement and Sale. [No. 18.]
2. To the 12 Quaeries published in June 1685. [*]
3. A Small History of Rebellion.
4. Accompts concerning the same.
5. Remarques upon the Peace of 1648.
6. Upon His Grace the Duke of Ormonde.
7. A Sermon for the 23 October[2] Aniversary. [*]
8. The 14 Articles not of Faith but Sense. [*]
9. The State of the New Titles to Land in Ireland. [No. 24.]
10. Speculum Hiberniae. [*]

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[1] The *Correspondence* shows that in 1686 Petty was thinking of purchasing an English estate. Bedgebury (Kent), Marbury (Cheshire), and Patcham (near Brighton) had probably been considered by him in this connection.

[2] The anniversary of thanksgiving for deliverance in Ireland.

Publiq Matters

Continuation of the London Bills

1. Observations upon the Dublin Bills Corrected. [B. 20.]
2. An Essay upon the Growth of London. [B. 19.]
3. Upon the Multiplication of Mankind. [B. 17.]
4. Quaeries about Pensylvania and the Natives. [No. 113.]
5. Analysis Populi. [No. 51.]
6. Observation upon the Paris Bills. [B. 18.]
7. Comparison of London with Paris. [B. 18.]
8. Of France with England.
9. 28 Points Concerning England and the King. [*]
10. The Powers of the King of England. [Hull, 630.]
11. About the Church, Parliament, &c.
12. Quaeries about Ireland.
13. About Coynage, Small Money, and 50 Pieces (?) to the Shilling.
14. About Bankrupts. [No. 70.]
15. A System of Navall Matters. [*]
16. Quaeries to Doctor Gale.[1]
17. Proportions between England and Ireland.

No. 161

LIST OF SUBJECTS FOR ESSAYS

1. Geometry.
2. Arithmetic.
3. Astronomy.
4. Vibrations and Pendulum.
5. Other motion—4.
6. Navigations—3.
7. Guns and Powder.
8. Clocks and Watches.
9. Opticall.

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[1] ? Theophilus Gale, D.D., 1628-1678, philosophical writer.

10. Senses (?) and Music.
11. Smells and Tastes, Senses, Perfumes.
12. Colours.
13. Fermentations.
14. Distilation.
15. Anatomicall comparative.
16. Of Humors and excrements.
17. Of Milk, Butter, and Cheese.
18. Of Grafting.
19. Of Flowers and Botany.
20. Of Cloths, Felts and Paper.
21. Of Leather and Parchment.
22. Of Mercury.
23. Of Magnets.
24. Of Sugar, Salt, Allum.
25. Of Sulphur, Copper, Brimstone.
26. Of Oyle, Wax, Gums, Bitumen.
27. Of Bones, Hornes, Hayre, Hoofes, Nailes, Teeth, Ivory.
28. De motu ventorum et maris.
29. De Fontibus, Caelum, et Pluviis.
30. De aquis sitentibus (?).
31. Of Knitting, Weaving, Spinning.
32. Of Timber, Iron, Ropes.
33. Of Metallurgy—Lead, Iron, Copper, Silver.
34. Of Glasse and fritelities (?).
35. Of Life, Death, Health.
36. Naturall, and artificiall state of Kingdoms.
37. Of Glew, Mortar, Tarrs, Concrete, Sodder.
38. Of Timber contignations (?).
39. Of Stones and Bricks . . . marble.
40. Arsenic, vermillion, sublime ceruse, M . . . armonac (?).
41. Of Moon sense, Supposition, Generation.
42. Of Preservation by salt, vinegar, smoake, cold.
43. History of several fishings.
44. Of Fowling, and Netts, and Hunting.
45. Of Wines, Opium, Tobacco, Hemlock &c.
46. Mechanicall: of Pully, Screw.

47. Of Carriages—land, water, fire, ayre.
48. Of Pumps and Raising Water.
49. Of Locks and Keyes, Springs of all sorts.
50. Of Flues (?) Firestones, Smoking, Fuell, Candles, Lamps.
51. Of Ayre and Vacuum.
52. Water and Hydrostaticalls.
53. Of Cold, Freezing, Snow.
54. Military tactics.
55. Of Casting or Molds.
56. Of Figuration by graving wooden cutts, card making . . . marbling paper, chasing, watering . . .
57. Of Drawing in inke (?).
58. Of Turning.
59. Of Lacker, Varnish, Size, S . . . Soape.
60. Of Pearles.
61. Of Gems.
62. Of the Scale of Creatures.
63. Of Squares, Cubes, Quadrangular (?) powers.
64. Statutes about Manufactures and Physic.
65. Of the encrease of Man and other animalls.
66. Of Corne, Cattle, and Husbandry; and the food of animalls.
67. Of Iron and Steele and Wyre and Plates.
68. Of the Ages and Durance of animalls, vegetables, and mineralls.
69. Of the application of Gunpowder to other uses than guns.
70. Of Nidifications (?).
71. Animalls sleeping, retyring, and absconding in winter.
72. Of Scenes, Deformations (?), Perspective, and Legerdemyne.
73. Of Gold.
74. Of the comparative strength of animalls.
75. Of making just modells for Engines of strength.
76. Of Chymneys, Furnaces, Ovens, Stoves, bellowes (?).

77. Of the Plague and Epidemic diseases in severall climates.
78. The Geography of comoditys—where each grows best.
79. The history and nature of Coyning Money.
80. The oeconomicall Populus of a state.
81. Of Naturall Trade—its birth and growth and death.
82. Of Naturall Lawes, depending upon difference of places.
83. Chymicall.
84. Of Engines strengthening nature.

XXVII

PETTY AND THE DISPUTED AUTHORSHIP OF THE OBSERVATIONS ON THE LONDON BILLS OF MORTALITY

The Disputed Authorship

THE Natural & Political Observations on the London Bills of Mortality were published over the name of Captain John Graunt about the beginning of February 1662. These Observations constituted the first example of the use of the 'statistical method,' that is to say, of a reasoned analysis of recorded figures. It may therefore be claimed that their writer was the pioneer, and indeed the inventor, of the Science of Statistics.

Some years after the publication of the book it began to be whispered that Petty and not Graunt was the true author, and this view seems to have been for a time generally accepted. More recently, however, the question has been reopened, some critics taking the side of Graunt and some that of Petty. The last and most authoritative pronouncement on the subject was given in the *Economic Writings of Sir William Petty*, where, after carefully weighing the facts, in so far as they were then known, Professor Hull decided in favour of Graunt.

It has now become possible to put forward some new and important evidence in Petty's favour, arising from the further exploration of his hitherto unpublished papers.

I do not intend to treat the question *de novo*, and will assume that my readers are acquainted with the general lines of the arguments on both sides as set forth by Hull. The evidence is some of it direct and some internal.

In the former category the statements have been cited of four of Petty's contemporaries—Evelyn, Aubrey, Halley, and Burnet. Two of them knew him well, and all asserted that he was the author. To Aubrey's evidence in favour of Petty, as recorded in his *Lives*, can now be added his further statement made in 1671 that a book of Observations on the Custom House Bills might be made "as Sir W Petty hath done of the Bills of Mortality" (i, 172 *supra*).

Two fresh witnesses on Petty's side can also be produced in the persons of Robert Southwell and John Houghton, both contemporaries and both fellow members of the Royal Society. On 25th November 1682 Petty sent Southwell an advance copy of his *Observations on the Dublin Bills of Mortality*. It will be remembered that this pamphlet was in the first instance published as " by the Observator on the London Bills of Mortality," though in a second edition it appeared as " by Sir William Petty," thus implying that he had been the original 'Observator.' Here is Southwell's comment: " I have the favour of yours of the 25th instant, and in it some of the Rich ore of that same old mine. Herein I first congratulate that you take home the Prodigal son (I should indeed have said it of the Father) and that you let the world see plaine, what they still suspected, that the spirit of Sir Wm. Petty and not of John Graunt presided in those Bills of Mortality—Poore John, though in his purgatory, can hardly drive such points, as by your allowance he ventured on while here, in his state of fudling (?) and of frailty. The good man was herein like a dwarf mounted on an elephant " (*Corr.*, 28th November 1682). Southwell knew Graunt almost as well as he knew Petty, and though his metaphor is somewhat involved, it leaves us in no doubt as to his views. Petty's reply to this letter is not extant, and we shall never know whether he accepted or denied Southwell's 'soft impeachment.'

For the discovery of Houghton's evidence I am indebted to Mr. R. H. Tawney, who happened upon it while this work was already in the press. It is to be found in *A Collection of Letters for the improvement of Husbandry & Trade* published in 1681, wherein the following passage occurs (p. 147): " Major Graunt, or rather that learned and Ingenious virtuoso, Sir William Petty, in his admirable Observations of the Bills of Mortality of London—a book useful to a multitude of Persons and a pattern for many other Great Designs—This great man, I say on page 14 of his second edition, saith etc. . . ."

Now Houghton was himself a prolific writer on economic questions, and as such would have been specially interested in establishing the true source of a contemporary work on his own subject. As a member of the Royal Society he must have known both Graunt and Petty well, but there is nothing to show that he was intimate with either. His categorical expression of opinion may therefore be accepted as both authoritative and impartial.

Another piece of direct evidence for Petty is that which he himself gives in the list of his writings printed *supra* (No. 158), in which (under date 1660) there appears the entry, " Observations on the Bills of Mortality." This entry, though passed over by Hull without comment, seems worthy of some attention. The list in question was in the first instance printed by Fitzmaurice from a copy made by Lord Shelburne (*Life* [9] and 317) a hundred years later, and several errors have crept into it. Amongst others the original date has been omitted and Petty's *Quantulumcunque* (which was only published in 1682) has been added, thus giving to the document the appearance of having been written after the year 1682. The original MS. from which Shelburne's copy was made is, however, extant, and will be found correctly printed above (No. 158). It is entirely in Petty's hand and is endorsed " 1671." There can, at that date, have been no question of confusion in Petty's mind as to what he had, or had not written, only nine years (and not twenty years) before. Moreover, the accuracy of the list can be proved in other respects, for most of the works it mentions have now been found among the MSS. It is clear that it was made, like the two lists which follow it (Nos. 159 and 160), for his own satisfaction and for his own eye—to be afterwards, no doubt, put away with the miscellaneous collection of papers from which the present volume has been compiled. Two questions must therefore be asked of those who wish to maintain Graunt's authorship: (1) What possible object, other than recording the actual fact, could Petty have had in claiming in a private document what he always refused to claim publicly? (2) Why, if he was attempting to claim what was not his own, did he take the trouble to date the work two years before it was published?

I come now to the question of internal evidence, that is to say, of the parallels which are discernible between certain passages and expressions in the *London Observations*, and others in Petty's published works or unpublished writings. The list which Hull gives (xliv, note) of these parallels in the *Works* can be now reinforced by many additional instances from the *Writings*. There is indeed scarcely a page of the *Observations* which does not forcibly recall some passage of Petty's known authorship.

I will take the various portions of the *Observations* in the order in which they are printed (Hull, 319-435).

In the first 'Epistle Dedicatory,' to Lord Robarts, the writer gives a list of subjects wherein, as he conceives, lessons can be drawn from a study of the Bills of Mortality. Amongst them are Beggars, Multiplication of the people, methods of dealing with the Plague, proportions between Males and Females, the Size and Growth of London, the disproportion of Parishes, the smallness of London within the walls, the number of fighting men available near London, and the want of a census for the purposes of levying Poll-money. All these are subjects which are mentioned, some of them with frequency, in Petty's *Papers*. Attention may also be called to a passage in the same part of the work, in which allusion is made to Diamonds and the Journeyman Jeweller, for Petty had been a journeyman jeweller in his day and wrote the *Dialogue of Diamonds* (Hull, 624-630).

Petty was, and Graunt was not, a member of the Royal Society at the beginning of 1662. I do not think it has been hitherto noticed how intimate a knowledge of the doings of that Society is betrayed by the writer of the second 'Epistle Dedicatory' to Sir Robert Moray. He hails it as a 'Mathematical, Mechanical & Physical' council—almost in the same words as those used elsewhere by Petty, and he speaks as Petty does in one of his medical papers of the necessity of 'luciferous' experiments. Here also may be observed allusions to the want of a Universal Measure in Trade, to Music, to Pendula and Vibrations, and to 'Exercitations about air'—all subjects in which Petty is now proved to have been keenly interested.

Passing on to the body of the book, I will not dispute Graunt's authorship of the two-page 'Preface,' nor that (having in the first instance obtained the actual Bills from Mr. Bell, the Parish Clerk) he, as a business man, skilled in accounts, would have been much more likely to collate and tabulate the figures systematically than his short-sighted and often careless friend (chapter I).

But in chapter II Petty's hand I think once more appears, as for instance in the distinction between 'Acute & Epidemical diseases,' in the use of the word 'Ratiocination,' and in the special reference to the 'diseases of metal-men.'

In chapter III Petty may be discovered once more in the talk about Beggars and Impotents, and the special mention of their absence in Holland. A careful search (which I have not had the patience to undertake) through Petty's medical

MSS. would no doubt show that some of the abstruse medical details of this chapter are common to both. They must surely, at any rate, have been altogether beyond a haberdasher's ken.

For chapters IV, V, and VI I must refer my readers to the papers on the Plague (Nos. 14 to 16) in this volume, while reminding them that they are only a fraction of those on this subject among the Petty MSS.

Chapter VII deals with the question of the excess of births over deaths at different places and times, with Immigration from the country into London, with Inequality of Representation, with the average number of people per Parish, and the average number of acres per head of the population—all once more matters on which Petty was fond of expressing his views.

Chapter VIII, on the numbers of Males and Females, Teeming women, Polygamy and Caelibates, is completely 'Pettian.' We find in its fourteenth section Petty's favourite dictum that Land is the mother and Hands the father of all Wealth, while in the final paragraph there is discussed the cost of keeping three wives as against one, a line of thought which reappears in the paper on Californian Marriages (No. 93 *supra*).

With chapter IX, on the Growth of London, may be compared Petty's Essay on the same subject published in 1682, as well as Nos. 12 and 13 in this volume.

In chapter X the author passes to the Inequality of Parishes, a subject on which Petty was never tired of descanting. He calls attention also to the fact that many ministers had not a living wage, a matter which Petty set himself later on to remedy, by suggesting the combination of the Parson's legitimate functions with those of publican and tax-gatherer (No. 44).

Chapter XI, 'Of the number of Inhabitants,' treats once more of the subject of Teeming women, and the extent to which those of London were performing their function by increasing the population. It concludes by giving the time of doubling as sixty-four years (*cf.* Nos. 94 and 95 and *Corr.*).

Chapter XII, as has been already pointed out, is entirely founded on the statistics for Romsey in Hampshire, Petty's home.

In the final chapter, headed 'Conclusion,' we may note references to 'Land & Hands,' to 'Voluptuaries' and 'Gamesters,' to some 'who live by puzzling poor people with unintelligible notions in Divinity & Philosophy' and others 'by persuading them that their bodies & Estates are in danger,' to 'Trades of Pleasure or Ornament,' and to those who, living '*ex sponte creatis*,' do nothing to assist a nation's trade. All these are again the very figures of speech employed elsewhere by Petty.

And lastly the Appendix contains some Observations on the Dublin Bills, which could not possibly have been made by Graunt, and were most certainly the work of Petty,—to be afterwards continued and amplified in 1681.

I have appended to this chapter a list from which the parallel passages to which I have referred may be verified. In the first column will be found the page or pages on which the subject is mentioned in the *London Observations* (as reprinted by Hull in his *Economic Writings*); in the second the nature of the allusion; and in the third the page references to the present volumes.

Now it may be at once admitted that no one of the parallels which I have indicated above is in itself conclusive, but I submit that cumulatively they constitute an irresistible plea for Petty's authorship.

If like ideas or expressions were to be found in other works by Graunt it might be otherwise, but it seems more than doubtful whether Graunt ever wrote anything else, except some Observations about the Excise, which were never printed. It may (as Hull urges) not be conclusive that because he did not write a second book he cannot have written a first; but it would indeed be strange that a brain sufficiently fertile to initiate in 1662 an entirely novel form of reasoning from numbers, should thereafter have produced nothing except one solitary communication to the Royal Society about the growth of Carp!

It has been said that the *Observations* differ in their style from Petty's writings. I confess that I cannot perceive this difference, though they are perhaps somewhat better put together than were most of Petty's papers. This would be explained if—as I think must have been the case—Petty merely set down his Observations or comments in the first instance, and left to Graunt the actual arrangement and publication of the book. Petty, as we now know, wrote a set of Observations about 1653 (No. 147) and another in 1671 (No. 148). Though they are not actually so named by him, the first may properly be described as 'Natural' and the second as 'Political.' In each case these consisted merely of a numbered series of conclusions, without headings or chapters, evidently put down just as they came into his head. If, as I am supposing, he wrote Graunt's 'Natural & Political' observations in 1660, they also would, in the first instance, have probably appeared in the form of what Petty describes a 'tumbling composition' (*supra*, ii, 226) requiring considerable editing. Now the London Observations were published early in 1662, but Petty was in Ireland—immersed in questions of Irish Land, and in his plans for the 'Double Bottom'—during the greater part of the previous year. Thus, assuming that he wrote them, he would not have been in a position, even if he had so desired, to have superintended their publication, while Graunt, as his representative and friend in England, would have been the most likely person to whom this duty would be relegated.

It may be asked whether the Observations, if not in Petty's style, do reflect that of Graunt? In the absence of any other work from Graunt's pen this question would be impossible to answer. We can, however, form an idea of his style from some letters—three written to John Petty (Sir William's agent in Ireland) in 1660, and one written to Petty himself in 1663—which are among the MSS., together with a curious petition 'From the Roman Catholics of Ireland to the Parliament' in Graunt's hand. All these, it may at once be said, are written in correct, but distinctly 'matter-of-fact' English, and bear no trace of the originality in thought and expression which characterizes almost every line of Petty's writing, whether epistolary or otherwise.

Graunt was no doubt, as we are told, possessed of all the virtues—a man of marked integrity, a good friend, an excellent haberdasher—but for the reasons I have given I cannot believe that he wrote the *London Observations*. Petty, on the other hand, had the necessary knowledge and mental equipment. If all the ideas mentioned in the Observations, and subsequently developed by Petty, were really Graunt's, Petty must surely stand convicted as one of the greatest plagiarists of the ages. It would be strange that, though his enemies were not a few, no such charge was brought against him.

Why then should he have allowed Graunt to publish the Observations over his own name? The answer, I think, is not hard to seek. As I have already stated in the preceding pages, Petty wrote or, as he preferred to call it, 'ratiocinated' (on paper) for his own satisfaction, and not for literary fame. Whether this was from diffidence in his powers, from fear of offending, from a distaste for the correction of his own MS., or because he was generally immersed in his business affairs, it is hard to say. Possibly he was actuated by a mixture of all these reasons, but at all events he was inclined to shun the publisher.

He had printed nothing but a couple of short tracts before 1662, and he may well have been unwilling—especially at that moment when Irish interests were once again in the melting-pot—to call too much attention to himself as an 'imaginer of vain things,' for a favourable reception of his new ideas was by no means certain in advance.

Graunt, on the other hand, was less vulnerable. His position was well assured; he had few enemies, and a book about London would come naturally from him, one of its most esteemed citizens. He was Petty's friend and partner. They had been associated together in the purchase of Petty's city property at Tokenhouse Yard in 1659, as well as in other enterprises, while Graunt appears to have generally acted as Petty's agent during the latter's absences in Ireland. It was through Graunt's influence that Petty had become Professor of Music at Gresham College.

Petty very likely began to 'ratiocinate' by way of Observation on one or two stray Mortality Bills which may have fallen into his hands—and wishing to widen the enquiry, called in Graunt to help him. Graunt, at all events, did most of the actual work in collecting and collating the Bills. He says so himself in the Preface (p. 333), and his statement is corroborated by John Bell, Clerk of the Company of Parish Clerks (Hull, xliii).

Now let us suppose that Graunt, who undoubtedly took a great interest in matters Economic and Philosophic, informed Petty in 1661 that he had an ambition to belong to the newly formed Royal Society. It would have been hard for Petty, himself one of the original members, to refuse his help. On the other hand, what would have been simpler than to make a present to Graunt of the *London Observations*, as just written in the rough, to suggest to him that they should be worked up into a book and printed with the tables (on which Graunt had spent so much time), and that the whole might be dedicated by him to the President of the Royal Society—with perhaps happy results.

We must not be unduly wise after the event. Neither Petty nor Graunt can have had the remotest idea that the book was going to attract so much attention, still less that it would make history. Petty therefore could not tell in advance how much he was giving away, nor Graunt that the gift would place him in a literary position which he was scarcely able to maintain. If the Observations had not been such a success nobody would have ever bothered their heads about their authorship, and indeed it is only in comparatively recent times that the question has attracted serious attention. What, then, becomes of the deep laid ' conspiracy ' and the ' contemptible conduct ' in which both Graunt and Petty would (according to some) have involved themselves by an arrangement such as that which I have supposed? As we have already seen, five well-known writers state that Petty was the real author—but none of them suggests that any blame attaches either to him or to Graunt for deceiving the public. Neither does Southwell who, like many others, had guessed it long ago.

Sir Peter Pett had surely guessed it also. He was one of Petty's closest friends. Hull takes Pett's obvious unwillingness (Hull, xliv) to mention the person whom he describes as ' the most curious Observator ' by name, as proof that he thought Graunt the author, but did not wish to say so. I should suggest that it indicates that Pett knew Graunt was *not* the author, but wished, even after Petty's death (1688), to preserve the secrecy which his friend had insisted upon when alive.

Nobody, at all events, was a penny the worse, unless it be Petty himself, who has had in consequence to forego the posthumous credit of being the true ' inventor of statistics.' I think we may safely assume that the members of the Royal Society were glad to welcome among them so worthy and popular a citizen as John Graunt, quite apart from his Literary and Scientific attainments, and that they would not have been greatly disturbed if they had known (as most of them apparently did know after a time) that his ' qualifying essay' was in the main the work of another. There are still Societies who require such evidence of fitness for membership. Would they consider it a very serious offence if it was discovered that one of their members, entirely eligible in all other ways, had not written his essay or article unaided?

The *London Observations* are frequently mentioned in Petty's printed *Works*, and almost always with the addition of Graunt's name. The same applies to his letters to Southwell, where subsequent even to the passage quoted at the commencement of this chapter, we find Petty alluding to 'what Captain Graunt and myself' had written on the London Bills (*Corr.*, 25th December 1686). Graunt had then been twelve years in his grave. If Petty had desired to claim the authorship it is evident that he could have done so without fear of contradiction. Though he resisted the temptation to take the credit which was his due, there can, I think, be no reasonable doubt that the Observations on the London Bills were in all essential respects his own work.

Parallel passages in the London Observations and Petty's unpublished writings

In the London Bills of Mortality (Hull's Edition)	Subject and page numbers in the present volumes
320, 385, 394.	Proportion between Males & Females. II. 115, 232.
321.	Size & position of London. I. 29; II. 263, 266.
321.	Need of census for Poll Money. I. 94, 96, 173, 182-4, 185.
321, 382, 395.	Disproportion of Parishes. I. 12, 14, 172, 266; II. 237.
321, 394.	Fighting men in London. I. 36; II. 71.
322, 348.	Bacon's *History of Life and Death*. I. 187.
323.	Mathematical, Mechanical & Physical sciences. I. 35, 41, 276.
323.	Luciferous experiments. II. 168.
324.	Vibrations & Pendula. I. 156; II. 207-8, 266.

In the London Bills of Mortality (Hull's Edition)	Subject and page numbers in the present volumes
347, 349, 350, 351.	Epidemical & acute diseases. I. 188, 195, 198; II. 116, 170, 269.
347, 363-8.	Plague &c. I. 37-40, 274, etc.
347.	'Ratiocination.' I. 107, 207; II. 22, 196.
348.	Deaths from age & from disease. I. 188, 195; II. 169.
350.	Diseases of 'metal' men. I. 195; II. 170.
350, 351, 368.	Healthfulness of the air & seasons. I. 188, 195; II. 170, 192, 269.
353.	Beggars & Impotents. I. 33, 178, 194, 200, 259; II. 63, 210, 238.
353, 354.	Holland. I. 247; II. 185-6, 229, 236, 261, etc.
356.	The French pox. II. 261.
358.	Telescopes. II. 29, 180.
358, 375.	A husband for every woman. I. 267; II. 49, 54, 57, 113.
361.	Deaths in childbed. II. 233.
361.	Child bearing in America. II. 116.
362.	Heterodox believers. I. 174; II. 235.
362.	Advantages of a Registry. I. 77-90, 172-5; II. 235.
370.	Inequality of representation. I. 8, 12, 193.
372	Acres per head of population. I. 208, 267; II. 56, 112.
372.	Husbandry the fundamental trade. I. 208, 212; II. 236.
374.	Exercises as promoting breeding. I. 188, 189.
377, 395.	Lands & Hands. I. 89, 179, 196, 256.
377.	Coelibates. I. 194; II. 264.
378.	Cost of keeping wives. II. 52-3.
383.	Stipends of ministers. I. 141; II. 236.
384, 394.	Numbers of teeming women. I. 34, 96, 194, 263, etc.
387-8, 394.	Doubling or Multiplication of the People. I. 36, 67, 256, 257, 267; II. 55-7, 130, 233, 263, 266, 268.
395, 396.	Voluptuaries. I. 108.

In the London Bills of Mortality (Hull's Edition)	Subject and page numbers in the present volumes
396.	Statistics of intrinsic value. Ch. VII, etc.
396.	'Ex sponte creatis.' I. 211.
396.	Gamesters. II. 237, 238.
396.	Divines. II. 190-1.
397.	Trades of pleasure & ornament. I. 90, 213; II. 239.
401, 402.	Amsterdam. I. 84; II. 155, 223.

APPENDIX

A list of Sir William Petty's printed writings with short titles (*from Hull's Bibliography*, 633-652).

1. The Art of Double writing. 1648.
2. A Broadside on the same.
3. Advice to Mr. Samuel Hartlib. 1648.
4. Proceedings between Sir Hierom Sankey and Dr. William Petty. 1659.
5. Reflections upon some persons and things in Ireland. 1660.
6. Treatise on Taxes and Contributions. 1662.
7. On the common practices of Dying. 1667.
8. On Duplicate Proportion &c. 1674.
9. Colloquium Davidis cum anima sua. (104th Psalm.) 1678.
10. Quantulumcumque concerning Money. 1682.
11. The Present state of England and England's guide to Industry (Political Arithmetic). 1683.
12. On the Dublin Bills of Mortality. 1683.
13. Another Essay in Political Arithmetic—Growth of the city of London. 1683.
14. On Land-Carriage. (Philosophical Transactions No. 161.) 1684.
15. On Mineral Waters. (Phil. Trans. No. 166.) 1684.
16. Catalogue of Experiments. (Phil. Trans. No. 167.) 1685.
17. Multiplication of Mankind (with an essay in Political Arithmetic). 1686.
18. Two Essays in Political Arithmetic (London and Paris). 1686.
19. Further assertion on the Magnitude of London &c. (Phil. Trans. No. 185.) 1686.
20. Further observations on the Dublin Bills. 1686.
21. Observations upon London and Rome. 1687.

22. Five essays in Political Arithmetic. 1687.
23. Political Arithmetic. 1690.
24. Political Anatomy of Ireland, with Verbum Sapienti. 1691.
25. An account of New Inventions and Improvements &c. with a Treatise of Naval philosophy. 1691.
26. Several Essays in Political Arithmetic (including 17, 18, 20, 21, 22 and 23). 1699.
27. Tracts relating to Ireland (including 6, 18, 24). 1769.
28. Of making cloth with sheep's wool. (History of the Royal Society.) 1756.
29. The Elements of Ireland. (Royal Irish Academy.) 1873.
30. A Compleat Treatise of Navigation. (Phil. Trans. No. 198.) 1693.
31. History of the Down Survey. 1851.
32. Upon the Trade in Irish cattle. Broadsheet.
33. A Geographicall Description of the Kingdom of Ireland (maps). [? 1689.]
34. Hiberniae Delineatio (maps). [? 1683.]

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